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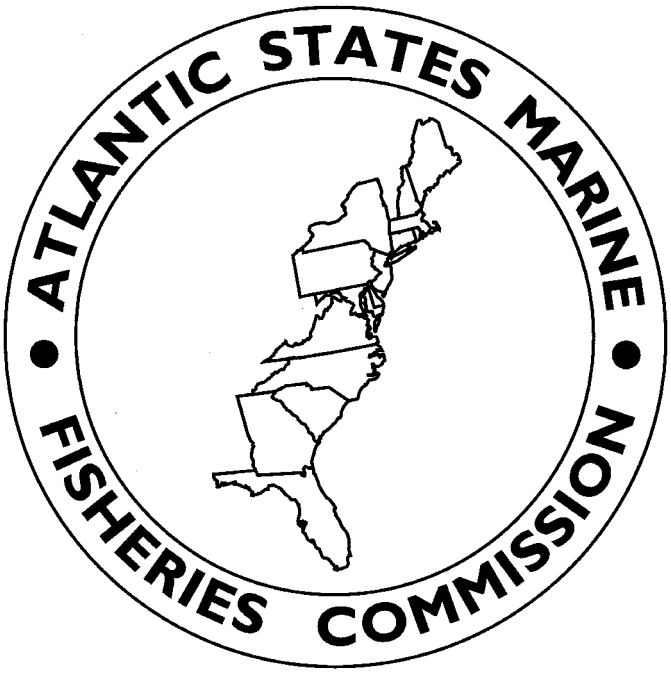

Prioritized Research Needs in Support of Interjurisdictional Fisheries Management

June 2004

Atlantic States Marine Fisheries Commission
Prioritized Research Needs
in Support of Interjurisdictional Fisheries Management

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with assistance of the
Management and Science Committee

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Acknowledgments

The Atlantic States Marine Fisheries Commission (Commission) would like to thank all state, federal and university representatives who contributed to the completion of this document. Identification and prioritization of research needs was provided by members of various Commission committees, including species stock assessment subcommittees, technical committees, advisory committees, plan development and review teams, and management boards. Input was also provided by the Commission's Habitat Committee, Committee on Economics and Social Sciences, and Management and Science Committee. The Commission would also like to acknowledge the efforts of Geoff White, Jeffrey Brust, Cecilia Butler, and Tina Berger for their assistance in coordinating these efforts. The research needs topics listed in this publication are consistent with those developed by the National Marine Fisheries Service Northeast Fisheries Science Center for organization and classification of Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC) research recommendations.

The Commission extends its appreciation to the members of the Management and Science Committee for providing oversight to the effort to identify and prioritize Commission research needs.

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Introduction

Research needs listed in this document were identified from Atlantic States Marine Fisheries Commission (Commission) fishery management plans and amendments, annual plan reviews, special reports conducted by the Commission on species technical and stock assessment issues, Stock Assessment Workshop (SAW) documents conducted by the National Marine Fisheries Service (1996 - 1999), and Commission external peer reviews. This publication is an update of Special Report #62 Prioritized Research Needs in Support of Inter-jurisdictional Fisheries Management published by the Commission in January 1997. Updates are periodically published via the Commission's website at www.asmfc.org.

Research needs were prioritized by Commission stock assessment subcommittees and technical committees under the purview of the Plan Development/Review Teams. Additional input to priorities is provided periodically by Advisory Committees, Management Boards, the Habitat Committee, the Committee on Economics and Social Sciences, and the Management and Science Committee. The prioritized research needs in this document should not supplant any prioritization conducted by Commission technical committees or management boards on an annual basis, or in any way hinder the management process.

This document is formatted in two major sections:

- Research needs listed by species; and
- Research needs listed by research topic.

It is the intent of the Commission to periodically update this document as research needs are either met or as new research needs are identified. Research needs that have been met since previous publication of this document have been moved to a separate section for each species and appropriate references have been included. The overall purpose of this document is to encourage state, federal and university research programs to develop projects to meet the research needs of Commission-managed species and thereby improve the overall management of these fisheries. It also hoped that state, federal and non-profit organizations will utilize this document in prioritization of research projects for future funding programs.

Research Needs
By Species

American Eel

Prioritized Research Needs

1. Documentation of the commercial eel fishery should be more accurate so that our understanding of participation in the fishery and the amount of directed effort could be known.

2. A stock assessment committee should identify the best stock assessment methods for American eel.

3. Investigate survival and mortality rates of different life stages (leptocephalus, glass eel, yellow eel, and silver eel) to assist in the assessment of annual recruitment. Such research could be aided by continuing and initiating new tagging programs with individual states.

4. Regular periodic stock assessments and determination of fishing mortality rates (F) are required to develop a sustainable harvest rate in addition to determining whether the population is stable, decreasing, or increasing.

5. Evaluate the impact, both upstream and downstream, of barriers on eel with respect to population and distribution effects. Determine relative contribution of historic loss of habitat to potential eel population and reproductive capacity.

6. Triggering mechanism for metamorphosis to mature adult, silver eel life stage with specific emphasis on the size and age of the onset of maturity, by sex. A maturity schedule (proportion mature by size or age) would be extremely useful in combination with migration rates.

7. A coast wide sampling program for American eel should be formulated using standardized and statistically robust methodologies. A critical review of the existing sampling plan should be conducted.

8. Investigate: fecundity, length and weight relationships for females throughout their range; growth rates for males and females throughout their range; predator-prey relationships; behavior and movement of eel during their freshwater residency; oceanic-behavior, movement and spawning location of adult mature eel; and all information on the leptocephalus stage of eel.

9. Assess characteristics and distribution of eel habitat and value of habitat with respect to growth and sex determination.

10. Age at entry of glass eel into estuaries and fresh waters should be examined.

11. Location and triggering mechanism for metamorphosis from leptocephalus to eel should

be examined.

12. The historic participation level of subsistence fishers in wildlife management planning needs to be reviewed, and relevant issues brought forth with respect to those subsistence fishers involved with American eel.

13. Investigate, develop, and improve technologies for American eel passage upstream and downstream of various barriers for each life stage. Emphasis should be placed on evaluation of low-cost alternatives for passage.

14. Economics studies are necessary to determine the value of the fishery and the impact of regulatory management.

15. Examination of the mechanisms for exit from Sargasso Sea and transport across the continental shelf.

16. Mechanisms of recognition of the spawning area by silver eel, mate location in the Sargasso Sea, spawning behavior, and gonadal development in maturation should be researched.

17. Contaminant effects on eel and the effects of bioaccumulation with respect to impacts by age on survival and growth and effect on maturation and reproductive success should be researched.

18. Migratory routes and guidance mechanisms for silver eel in the ocean should be examined.

19. Examine the mode of nutrition for leptocephalus in the ocean.

20. Provide analysis of food habits of glass eel while at sea.

21. The degree of dependence on the American eel resource by subsistence harvesters such as Native American Tribes, Asian and European ethnic groups, etc. needs to be investigated.

22. Workshop on aging and sexing techniques should be considered to increase the accuracy of data collected in coastwide sampling program.

23. Determine mortality rates at different life history stages (leptocephalus, glass eel, yellow eel, silver eel), and mortality rates with size of the yellow eel stage. Determine sustainable fishing mortality rates (F) for eel.

24. Investigate fecundity, length and weight relationships for females throughout their range, and growth rates for males and females throughout their range.

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Barse, A. And D.H. Secor. 1999. An exotic parasite of the American eel. Fisheries 24 (2): 6-19.

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Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

Weeder, J. 1998. Maryland American eel population study. Completion Report - Project 3-ACA-026, Maryland Department of Natural Resources, MD.

Notes:

Drs. Dave Secor and Joel Baker are conducting a three-year study of the "Ecology and contamination of Hudson River American eel", (1998-2001) which is funded by the Hudson River Foundation.

Objectives of their research are to:

1. Describe regional age and size composition of yellow-stage eels throughout the Hudson River estuary.
2. Estimate local abundances of yellow eels along Hudson River's estuarine gradient.
3. Estimate individual growth rates of eels collected throughout the Hudson River based upon analysis of otolith microstructure and tag-recapture.
4. Measure dispersal rates of eels after two months (brands) and after one and two years (PIT tags) within the Hudson River Estuary. Measure longer term trends in estuarine dispersal using otolith microchemistry.
5. Map region-specific growth and mortality rates and yield-per-recruit for Hudson River eel.
6. Assess the PCB contaminate level of eels at six sites up and down the Hudson River Estuary.
7. Determine the prevalence of the parasitic nematode, *Anguillicola crassus* in Hudson River eels.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new Chesapeake Bay Stock Assessment Committee (CBSAC) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Ms. Wendy E. Morrison is completing her research for a M.S. degree this fall. Her thesis is entitled: "Population dynamics of American eels in the Hudson River, New York". An abstract of her research, which will be presented at the American Eel Symposium at the 2003 Annual American Fisheries Society Meeting follows:

> High PCB contamination resulted in a ban on Hudson River eels harvested for human consumption since 1976. The closure, while unfortunate, provides a unique opportunity to study stock dynamics in the absence of significant exploitation. Age and size structure, growth, local abundance, short term, and long term dispersal were evaluated using mark-recapture experiments inside 144 ha grids each composed of 36 baited pots. Grids were arrayed over six sites encompassing the entire tidal portion of the river from mesohaline habitats near Manhattan to freshwater habitats at Albany, 230 kilometers upriver. During 1997-1999, over 30,000 freeze brands and 1200 PIT tags were applied. Local abundance was highest at mid-river freshwater sites. Older and larger eels tended to occur at upriver freshwater sites; younger eels were almost exclusively captured at brackish water sites. Summer growth was significantly greater at brackish water sites (1.5 cm mo-1) than at freshwater sites (0.5 cm mo-1). The exotic nematode *Anguillicola crassus* infected eels at every site, although prevalence varied widely. Recapture eels showed very little dispersal during the 2- and 12-month experimental periods. Home range was estimated to be less than 5 km. Limited dispersal suggested a strong link between local habitat condition and yellow eel production.

Research Needs Identified As Being Met

Evaluate the use of American eel as a water quality indicator.

Investigate practical and cost-effective methods of re-establishing American eel in underutilized habitat.

American Lobster

Prioritized Research Needs

1. Initiate studies of life history events (molting, extrusion, mortality, etc.) in older/larger lobsters on a regular basis.

2. Monitor the condition of the stocks and determine the effects of management measures and environmental changes on the abundance of the stocks and on the fisheries.

3. Resolve the question of stock identification, particularly as related to inshore/offshore components south of Georges Bank. Appropriate genetic studies are highly recommended and a compilation and analysis of existing tagging data should be undertaken prior to any new tagging studies. (Bruce Estrella complied tagging studies in the early 1990s. The Technical Committee concluded that this compilation was fruitless because many databases were lost and the lack of consistent information across studies made it difficult for comparisons. See Note in References Section concerning work being conducted by the NEFSC).

4. Yield-per-recruit analyses should be conducted for males.

5. Include process error in growth, reproduction, etc; and evaluate effects of assumptions of maximum intermolt periods, maximum size and the partitioning of natural mortality in the egg production per recruit model. Obtain information on molting frequency and lobster growth, mortality, and recruitment among years and geographical areas. (Estrella/Massachusetts has an ongoing hatchery study on this topic.)

6. Quantify changes in the spatial distribution of effort.

   Enhanced sea sampling and/or port sampling of offshore catches is urgently needed for biological characteristics of catches and landings since current sampling in these areas is considered inadequate for assessment purposes. (See Note Reference Section concerning work being conducted by the NEFSC)

7. Methods should be developed to derive standardized catch-per-unit-effort indices which include trap attributes, season, soak time, etc. Sea sampling should be modified to include collection of potentially important variables.

8. Estimates of biological reference points for the Gulf of Maine stock are partly influenced by the assumed level of v-notching undertaken by area fishermen. No adequate estimate of the proportion of compliance with this voluntary measure now exists. A credible study of this issue is recommended to reduce uncertainty in estimation of biological reference points. (See Note in Reference Section concerning ongoing work.)

9. Analyze effects of different spatial combinations of survey stations in the Delury model.

10. Develop area-specific data on effort and LPUE. (Forthcoming with ACCSP logbook)

11. Examine effects of measurement errors and define acceptable levels of risk in the egg production per recruit model.

12. Develop a monitoring plan to detect recruitment decline.

13. The inclusion of multiple survey indices in DeLury population models could potentially be useful in refining estimates of stock size and F, and should be explored.. (A preliminary version of the DeLury model with multiple indices has been developed, but was not available for SAW-22).

14. Predictions of EPR models should be validated with respect to data from fishery-dependent and fishery-independent sources including: length frequency distribution of catch, projected growth trajectory, and size-specific sex ratios, fraction egg bearing, fraction soft shell, and fraction V-notched.

15. Explore alternatives to timing of events in the EPR model. Investigate geographic and seasonal patterns of growth, reproductive events, and fishing intensity from catch and sea sampling data. Standardize methods of sampling and statistical analysis are needed to determine these patterns.

16. Obtain information on natural mortality rates. The effects of alternative partitionings of natural mortality (M) between hardshell and softshell should be investigated, and attempts should be made to estimate rates from field or laboratory data.

17. Examine the sensitivity of F (10%) to input parameters in the egg production per recruit model. Specific information for micro-area is needed.

18. Additional analyses of biological attributes of the catch and survey data are needed to corroborate patterns and trends in F estimates.

19. Examine temperature effects on growth, reproduction, etc. (Many lab studies have been done, but have not been related to the EPR model in the form of an environmental component.)

20. Conduct spatial mapping of survey indices and projected egg production.

21. More precise and accurate DeLury model estimates of stock size and fishing mortality rates can be made if the relative selectivity of pre-recruit and fully recruited sizes to the bottom trawl survey gear is resolved. Appropriate field studies of lobster availability and R/V gear selectivity are considered a priori.

22. Develop standardized LPUE-index fishers.

23. Investigate the effects of spatial distribution/movements/selectivity in the Delury model.

24. Examine trap effects on catch.

25. Undertake regional examination of temperature-yield relationship. (Estrella, Bruce, and Steven Cadrin. 1991. Massachusetts coastal commercial lobster trap sampling program, 1990 Annual Report. 52 pp.; Fogarty, Michael J. 1988. Time series models of Maine lobster fishery: Effects of temperature. Canadian Journal of Fisheries and Aquatic Sciences, Volume 45, 1145-1153.)

26. Examine temperature, effort, and abundance effects on catch.

27. Use comparative evaluations of reproductive rates with respect to temperature.

28. Terminologies for lobster life stages need to be defined and standardized for each state's sampling programs in order to ensure comparability and synthesis of available data.

29. Examine fixed and random sampling.

30. Include multiple input series in modeling for lobster.

31. Compare fishery-dependent and fishery-independent length frequencies. (Completed through stock assessment process but no formal document.)

32. Develop a time series of standardized fishing effort and compare with F.

33. Compile existing tagging data-transfer rates.

34. Compile existing larval data - transfer rates.

35. Examine spatial differences in F (10%) in the egg production per recruit model.

36. Evaluate potential biases in the Delury analysis due to incomplete coverage in different substrates.

37. Assess the utility of satellite DNA and apply throughout range, if promising. Genetic identity of LIS population should be examined. (Dr. Irv Kornfield, University of Maine, paper in press/process for LIS data; papers on utility of satellite DNA should be out. See Note in Reference Section.)

38. Conduct cooperative studies with fishers on gear efficiency.
39. Obtain information on operational and socioeconomic data for the commercial fisheries.

40. Undertake sensitivity analyses in the DeLury model.

41. Develop models with enhanced size/stage structure.

42. Test the thermal limit hypothesis.

43. Examine effects of predation, regime shifts, etc.

44. Establish field studies of density-dependent processes. (Bob Steneck in progress.)

45. Combined analyses of inshore and offshore southern stocks produced intermediate results, and were sensitive to the research vessel series (Rhode Island inshore or NEFSC offshore) used for DeLury modeling. Quantitative methods for combining stock status and reference points to multiple stock areas are necessary for providing region-wide assessment advice for the American lobster resource through its range.

46. Investigate spatial differences in demography of American lobster.

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Angell, T. E. April 12, 1996. Rhode Island lobster research and management project; 1995 Annual/Completion Report. NOAA Grant No. NA46FI0084. 34p. (Study conducted in Narragansett Bay, Rhode Island Sound, and Block Canyon to Hudson Canyon)

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Notes:

The Rhode Island Lobster Research and Management Project, which collects information on catch and biological characteristics, will expand sampling to offshore areas in 1997. Catch and length information is collected regularly from New York to Maine.

A monitoring plan to detect recruitment decline has been addressed by a Sea Grant study and has been met in the Long Island Sound by the Connecticut Department of Environmental Protection larval survey. The National Marine Fisheries Service has conducted some mapping of survey indices for American lobster.

The Stock Assessment Workshop (SAW) Invertebrate Subcommittee is working on inclusion of a spatial component in the length cohort analysis, and spatial differences in F (10%) in the egg production per recruit model. The subcommittee is also working to include reproductive output of sub-legal lobster where needed, to include process error in growth, reproduction, etc. and to evaluate the effects of mating behavior, sex ratios, and size structure in the egg production per recruit model.

A morphometric stock discrimination based on size at maturity was developed to classify lobsters to inshore or offshore parts of Southern New England (Cadrin 1995). An extensive examination of the evidence for a separate stock unit in Long Island Sound was undertaken based on evidence derived from tagging studies and inferences concerning larval dispersal.

In the latest assessment, the number of samples for offshore areas in Southern New England was increased through the sea sampling program conducted by the State of Rhode Island and by port sampling by NMFS. Samples derived from the Department of Fisheries and Oceans Canada augmented those derived from U.S. sources. Additional samples from the Domestic Observer Sampling Program were incorporated into the current assessment, and historical data from port samples were put into a computer database for the first time. Enhancement of sampling activities within the Gulf of Maine is still required.

A study is currently underway with Sea Grant funding in Maine, New Hampshire, and Rhode Island to develop a pilot program for an integrated system for monitoring the lobster fishery. This study specifically includes a component to quantify the proportion of V-notched lobsters in the catch based on voluntary logs and sea sampling information.

A preliminary version of the DeLury model with multiple survey indices has been developed to potentially refine estimates of stock size and F, but was not available for SAW-22. The inclusion of multiple survey indices in DeLury population models should continue to be explored.

Bruce Estrella from Massachusetts has an ongoing hatchery study to obtain information on molting frequency and lobster growth, mortality, and recruitment among years and geographical areas.

Many lab studies have been conducted to examine temperature effects on growth, reproduction, etc. However, these studies have not been related to the EPR model in the form of an environmental component.

Studies are currently being conducted by Robert Steneck to establish field studies of density-dependent processes.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Research Needs Identified As Being Met

Develop a database to calculate lobster landings by area caught, time period, sex, and length in a timely and efficient manner.

The Atlantic States Marine Fisheries Commission received a grant from the Atlantic Coastal Cooperative Statistics Program (ACCSP) in 2002-2003 to develop a lobster stock assessment database. This database is nearing completion as of April 2004 and will be used in the benchmark assessment for American lobster to be peer reviewed through the SAW/SARC process in late 2004 or early 2005.

Evaluate additional stock assessment models and analyses that could provide the basis for alternative biological reference points for lobsters that would complement the current $F_{10\%}$ maximum egg production per recruit reference point, and account for prevailing spawning stock size, total egg production, or recruitment.

The American Lobster Technical Committee has appointed a subcommittee to evaluate additional stock assessment models for American lobster. These models will be reviewed through a Commission technical review during 2004 in preparation for use of one or more new models during the 2004-2005 benchmark assessment.

American Shad/ River Herring

Prioritized Research Needs

1. Continue to assess current aging techniques for American shad and river herring, using known age fish, scales, otoliths, and spawning marks. Conduct bi-annual aging workshops to maintain consistency and accuracy of aging of fish sampled in state programs.

2. Determine and update biological benchmarks used in assessment modeling (fecundity at age, mean weight at age for both sexes, partial recruitment vector/maturity schedules) for American shad and river herring stocks in a variety of coastal river systems, including both semelparous and iteroparous stocks.

3. Validate the different values of M for shad stocks through verification of shad aging techniques and repeat spawning information and develop methods for calculating M.

4. Determine which stocks are impacted by coastal intercept fisheries (including bycatch fisheries). Methods to be considered to differentiate among stocks could include otolith micro-chemistry, oxytetracycline otolith marking and/or tagging.

6. Identify pheremones or other chemical substances used by American shad to locate conspecifics. Develop methods to isolate or manufacture these chemicals and use them to attract shad into fish passage facilities to improve fish passage and efficiency.

7. Develop effective culture and marking techniques for river herring.

8. Develop and implement techniques to determine shad and herring population targets for tributaries undergoing restoration (dam removals, fishways, supplemental stocking, etc.).

9. Evaluate and ultimately validate large-scale hydroacoustic methods to quantify American shad escapement (spawning run numbers) in major river systems. Identify how shad respond (attract/repelled) by various hydroacoustic signals.

10. Refine techniques for hormone induced tank spawning of American shad. Secure adequate eggs for culture programs using native broodstock.

11. Characterize tributary habitat quality and quantity for Alosa reintroductions and fish passage development.

12. Identify and quantify potential American shad spawning and rearing habitat not presently utilized and conduct an analysis of the cost of recovery.

13. Develop comprehensive angler use and harvest survey techniques for use by Atlantic states to assess recreational fisheries for American shad.

14. Determine the effects of passage impediments on all life history stages of shad and river

herring, conduct turbine mortality studies and downstream passage studies.

15. Evaluate additional sources of mortality for shad, including bait and reduction fisheries.

16. Conduct studies on energetics of feeding and spawning migrations of shad on the Atlantic coast.

17. Encourage university research on hickory shad.

18. Conduct studies of egg and larval survival and development.

19. Conduct and evaluate historical characterization of socio-economic development (potential pollutant sources and habitat modification) of selected shad rivers along the east coast.

20. Review studies dealing with the effects of acid deposition on anadromous alosids.

21. Conduct population assessments on river herrings - particularly needed in the south.

22. Quantify fishing mortality (in-river, ocean bycatch, bait fisheries) for major river stocks after ocean closure of directed fisheries.

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Notes:

Dr. Roger Rulifson, East Carolina University, Greenville, North Carolina (919-328-1757); and Joe Hightower, National Biological Service, North Carolina Cooperative Fish and

Wildlife Research Unit, Box 7617, NCSU, Raleigh, North Carolina (919-515-2631) have graduate students currently working on hickory shad in the Albemarle Sound area.

Studies to determine stream FMRs for American shad have been conducted within the following rivers in South Carolina during the years noted. Information produced by these studies is available in the form of National Marine Fisheries Service technical reports from PL89-304 funds for all years except 1994-1996. This information is part of a continuing project to be reported on in 1997.

1989 & 1990 - Edisto River
1991 & 1992 - Santee River
1993 - Combahee River
1994 - 1996 - Edisto River

Catch per unit effort records for American shad have been collected from selected commercial fishermen fishing in most state's rivers since 1979. These fishermen keep records on a voluntary basis. The results of all cpue analyses are contained in numerous National Marine Fisheries Service project completion reports.

A long-term mark or tag has been developed for juvenile American shad in the Susquehanna River.

The determination and partitioning of annual mortality rates for all major exploited American shad stock is currently being conducted for Amendment 1 to the 1985 Atlantic States Marine Fisheries Commission's Fishery Management Plan for American Shad and River Herring.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Extuarine Exosystems (TIES): http://www.chesapeake.org/ties/).

Dr. Ed Houde of CBL and Mr. Steven P. Minkkinen of Maryland DNR are Co-PIs of a two-year project funded by Maryland Sea Grant beginning 1/1/100 to evaluate and improve larval stocking as a method to restore American shad in the Chesapeake Bay. Although hatchery-spawned American shad larvae are the focus of a major restoration effort in Chesapeake Bay, environmental conditions that optimize larval stocking procedures are unevaluated. Larvae will be stocked into the Patuxent River at prescribed locations, dates, and ages to determine preferred conditions in the river that maximize survival and growth. The research will result in recommendations to resource management agencies on effective stocking strategies.

"Tetracycline marks will be placed onto otoliths of hatchery-spawned American shad larvae which will be stocked into the Patuxent River, MD in four experimental release during years 2000 and 2001. Recaptures of uniquely marked larvae will identify cohorts that experienced high or low survival and growth rates, and environmental conditions that were favorable or inhospitable. Thus the experimental larvae are "environmental probes" that can be utilized to gather fundamental knowledge of shad early life requirements and provide critical information to develop optimum stocking protocols."

CBL graduate student, Patrick Campfield, a Sea Grant Fellow has an important role in this study.

Research Needs Identified as Being Met

Determine the stock/recruitment relationships for American shad and river herring stocks.

Atlantic Croaker

Prioritized Research Needs

High Priority

Criteria should be cooperatively developed for aging croaker otoliths.

Studies of croaker growth rates and age structure need to be conducted throughout the species range.

Age-length keys that are representative of all gear types in the fishery should be developed.

Fishery dependent and independent size, age and sex specific relative abundance estimates should be developed to monitor long term changes in croaker abundance.

Improve catch and effort statistics from the commercial and recreational fisheries, along with size and age structure of the catch.

Examine reproductive biology of croaker with emphasis on developing maturity schedules and estimates of fecundity.

Medium Priority

Conduct stock identification research on croaker.

Cooperative coastwide croaker juvenile indices should be developed and validated to clarify stock status.

Evaluate hook and release mortality under varying environmental factors and fishery practices.

The effects of mandated bycatch reduction devices (BRD's) on croaker catch should be evaluated and compiled.

In trawl fisheries or other fisheries that historically take significant numbers of croaker, states should monitor and report on the extent of unutilized bycatch and fishing mortality on fish less than age-1. Incorporate bycatch estimates into croaker assessment models.

The optimum utilization (economic and biological) of a long term fluctuating population such as croaker should be evaluated.

Continue monitoring of juvenile croaker populations in major nursery areas.

Cooperatively develop a yield per recruit analysis to establish a minimum size that maximizes YPR.

Determine the onshore vs. offshore components of the croaker fishery.

Identify essential habitat requirements.

Low Priority

Determine migratory patterns and mixing rates through cooperative, multi-jurisdictional tagging studies.

Determine species interactions and predator/prey relationships for croaker (prey) and other more highly valued fisheries (predators).

Determine the impacts of any dredging activity (i.e. for beach re-nourishment) on all life history stages of croaker.

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Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

Notes:

In Barbieri et. al. 1994a the following research needs have been partially met:

Criteria should be cooperatively developed for aging croaker otoliths.

Studies of croaker growth rates and age structure need to be conducted throughout the species range.

Age-length keys that are representative of all gear types in the fishery should be developed.

Improve catch and effort statistics from the commercial and recreational fisheries, along with size and age structure of the catch.

In Barbieri et. al. 1994b the following research needs have been partially met:

Examine reproductive biology of croaker with emphasis on developing maturity schedules and estimates of fecundity.

In Barbieri et. al. 1997 the following research needs have been partially met

Cooperatively develop a yield per recruit analysis to establish a minimum size that maximizes YPR.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many

other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Extuarine Exosystems (TIES): http://www.chesapeake.org/ties/).

Atlantic Menhaden

Prioritized Research Needs

1. Evaluate effects of selected environmental factors on growth, survival and abundance of juvenile and adult menhaden, particularly in Chesapeake Bay and other coastal nursery areas.
Develop and test methods for estimating size of recruiting year-classes of juveniles using fishery-independent survey techniques.

   Determine how loss/degradation of critical estuarine and nearshore habitat affects growth, survival and abundance of juvenile and adult menhaden abundance.

   Monitor landings, size, age, gear, and harvest area in the reduction and bait fisheries, and determine age composition by area. Enhance biostatistical sampling of bait samples in purse seine fisheries for Virginia and New Jersey to improve stock assessment.

   Study the ecological role of menhaden (predator/prey relationships, nutrient enrichment, oxygen depletion, etc.) in major Atlantic coast embayments and estuaries.

   The feasibility of estimating yearclass strength using biologically stratified sampling design should be evaluated. The efforts could be supported by process studies linking plankton production to abundance of young menhaden (need resources).

2. Evaluate use of coastal power plant impingement data as a possible means to estimate young-of-the-year menhaden abundance.

   Monte Carlo simulations should be conducted to evaluate precision of VPA.

   Alternative measures of effort, including spotter pilot logbooks, trip length, or other variables, should be evaluated. Spotter pilot logbooks should be evaluated for spotter plane search time, GPS coordinates, and estimates of school sizes observed by pilots.

   Re-evaluate menhaden natural mortality, by age and response to changing predator population sizes.

3. Determine the effects of fish diseases (such as ulcerative mycosis and toxic dinoflagellates) on the menhaden stock.

   Determine the effects of regulations on the fishery, the participants and the stock.

   Growth back-calculation studies should be pursued to investigate historical trends in growth rate. The NMFS has an extensive data base on scale growth increments which should be utilized for this purpose.

4. Monitor fish kills along the Atlantic coast and use the NMFS Beaufort Laboratory as a

repository for these reports.

5. Develop bycatch studies of menhaden by other fisheries. DISCARDS

6. Periodically monitor the economic structure and sociological characteristics of the menhaden reduction industry.

List of References

Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

Notes:

Ongoing research is being conducted to develop and test methods for estimating size of recruiting year-classes of juveniles using fishery-independent survey techniques.

Ongoing research is being conducted to determine the effects of fish diseases (such as ulcerative mycosis and toxic dinoflagellates) on the menhaden stock.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Atlantic Sea Herring

Prioritized Research Needs

1. Identify known herring spawning areas. Establish critical spawning habitat areas or special management zones to protect spawning aggregations of herring and/or demersal egg masses.

   Develop a long-term strategy for assessing individual spawning stocks as a basis for more effective management of any heavily exploited portion(s) of the stock complex. Evaluate the merit of acoustic surveys and other techniques to achieve sub-stock complex monitoring.

2. Develop economic analyses necessary to evaluate the costs and benefits associated with different segments of the industry.

   Pursue the development of a dedicated pelagic survey technique utilizing hydroacoustic and trawling methods to provide another direct and independent means of estimating stock sizes. Collaborative work between NMFS, DFO, state agencies, and the herring industry on acoustic surveys for herring should be encouraged.

   Reinvestigate the estimation of age-3 herring, investigate the natural mortality rate assumed for all ages, the use of catch-per-unit-effort tuning indices, and the use of NEFSC fall bottom trawl survey tuning indices in the analytical assessment of herring.

3. Develop new approaches to estimating recruitment (i.e. juvenile abundance) from fishery-independent data.

   Consider using NEFSC fall survey mean weights at age as the spawning stock mean weight at age in the estimation of biological reference points. Evaluate alternative catch weights at age.

   Investigate alternative methods of estimating mean weight at age used to determine the age composition of U.S. and Canadian landings from the coastal stock complex.

   Conduct a retrospective analysis of herring larval and assessment data to determine the role larval data plays in anticipating stock collapse and as a tuning index in the age-structured assessment.

4. Continue resource monitoring activities, especially larval surveys to evaluate distribution and abundance of herring larvae, and to indicate the relative importance of individual spawning areas and stocks and the degree of spawning stock recovery on Georges Bank and Nantucket Shoals.

   Potential changes in catchability within spring bottom trawl survey indices should be investigated.

5. Develop socio-economic analyses appropriate to the determination of optimum yield.

   Evaluate the concept of a minimum biologically-acceptable level biomass (MBAL) for the herring coastal stock complex. Determine the adequacy of present methods and data to determine MBAL if appropriate.

   Evaluate the concept of a fixed spawning stock size or spawning target for the herring coastal stock complex. Determine the adequacy of present methods and data to set a target if appropriate.

   Investigate the effects of averaging maturity rates over blocks of years to help smooth some of the interannual variability in the calculation of spawning stock biomass.

   Possible effects of density-dependence (e.g. reduced growth rates at high population size) on parameter estimates used in assessments should be examined.

6. Consider potential discards if fishing mortality increases in the future.

List of References

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Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

***Notes**:*

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Research Needs Identified as Being Met

Investigate the validity of extremely high recruitment estimates in recent years.

Atlantic Striped Bass

Prioritized Research Needs

1. Develop refined and cost-efficient coastal monitoring regime for striped bass stocks, including spawning stock biomass modeling and virtual population analysis (VPA).

2. Conduct sensitivity analysis on current state and federal fishery dependent and independent monitoring programs to determine which, if any, may be eliminated.

3. An evaluation of the overfishing definition should be made relative to uncertainty in biological parameters.

4. Simulation models should be developed to look at the implications of overfishing definitions relative to development of a striped bass population which will provide "quality" fishing. Quality fishing must first be defined.

5. Quota calculation methods should be refined which allow better estimates among various components of the fishery.

6. Examine differential reporting rates between commercial and recreational fishermen using high reward tags.

7. Develop studies to provide information on the magnitude of hook and release and bycatch mortality, including factors that influence their magnitude and means of reducing or eliminating this source of mortality.

8. Further study should be conducted on the discrepancy in ages between scale-based and otolith-based ages. Particular emphasis should be placed on comparisons with known age fish determined from coded wire tags. Comparisons should be made among age readers and areas.

9. Increase sea sampling of commercial fisheries, such as the dogfish gillnet fishery, which may have high levels of discards.

10. Continue in-depth analysis of migrations, stock composition, etc. using mark-recapture data.

11. Continue to conduct research to determine limiting factors affecting recruitment and possible density implications.

12. Determine inherent viability of eggs and larvae.

13. Additional research should be conducted to determine the pathogenicity of the IPN virus isolated from striped bass to other warm water and marine species, such as flounder, menhaden, shad, largemouth bass and catfish.

14. Juvenile and adult surveys should be continued to determine the most cost-effective release strategies including age at release and optimal release conditions such as salinity, temperature, and time of day for future potential stocking programs.

15. Review relationship between tag based survival estimates and VPA estimate of mortality in a management framework.

16. Improve methods for determining population sex ratio for use in estimates of spawning stock biomass and biological reference points.

17. Develop maturity ogive applicable to coastal migratory stock.

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Notes:

The Atlantic States Marine Fisheries Commission initiated a project through its Management and Science Committee to address multispecies interactions and predator-prey relationships using Atlantic menhaden as a case study. This project will involve assessing the relationship between menhaden and predator species, such as striped bass, through multispecies and ecosystem modeling. This project was initiated during CY2000 and will be a multi-year project.

Secor, D., E. Houde, and Kellog have conducted recent studies on egg and larval viability, mortality factors affecting egg and post-finfold larval stages, and evaluation of climatological factors in relation to reproductive success. Completion reports will be provided to the National Marine Fisheries Service and Maryland Department of Natural Resources.

Drs. Dave Secro and A. Sharov: “Determination of frequency of anadromous migrations by Chesapeake Bay striped bass based on electron microprobe analysis of otoliths”, 2000-2001, funded by NMFS (MARFIN).

Objectives of Secor’s research are to:

a) Estimate age-specific and sex-specific probabilities of coastal use for a large sample (n = 200) of Chesapeake Bay male and female striped bass.

b) Estimate frequency of spawning for a moderate sample (n = 30) of Chesapeake Bay female striped bass.

c) Improve sensitivity and spatial resolution of election microprobe analysis of otolith Sr.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Research Needs Identified as Being Met

Investigate age-specific mortality rates.

Develop and execute methods to incorporate non-Maryland JAI's into a coastwide SSB model.

Examination of the tag-recapture models and development of a standard method for estimating bias should be conducted.

Determine the cumulative impact of losses to coastal stocks caused by industrial and municipal water intakes.

Identify spawning and nursery habitat areas in river systems.

Continue to survey recreational and commercial fisheries in order to quantify benefits of stocking programs to both pre-migratory and coastal populations.

A better understanding of the genetic implications of interactions between hatchery stocks and endemic populations is needed. Areas of concern include: loss of genetic variability among and within populations, tradeoffs (genetic) of supportive or supplemental stocking, and brood stock management practices.

Atlantic Sturgeon

Prioritized Research Needs

1. Obtain baseline data on habitat condition and quantity in important sturgeon rivers. Data should address both spawning and nursery habitat.

2. Characterize size, condition, and relative abundance of Atlantic sturgeon by gear and season taken as bycatch in various fisheries.

3. Determine the extent to which Atlantic sturgeon are genetically differentiable among rivers.

4. Develop methods to determine sex and maturity of captured sturgeon.

5. Research should be conducted to determine the susceptibility of Atlantic sturgeon to sturgeon adenovirus and white sturgeon iridovirus. Methods should be developed to isolate the sturgeon Adenovirus and an Atlantic sturgeon cell line should be established for infection trials.

6. Develop sperm cryo-preservation techniques and refine to assure availability of male gametes. Refine induced spawning procedures.

7. Encourage shortnose sturgeon researchers to include Atlantic sturgeon research in their projects.

8. Develop and implement long-term marking/tagging procedures to provide information on individual tagged Atlantic sturgeon for up to 20 years.

9. Evaluate aging techniques for Atlantic sturgeon with known age fish. Emphasis should be placed on verifying current methodology based on fin rays. Determine length, fecundity, and maturity at age for North, Mid and South Atlantic stocks.

10. Conduct basic cultural experiments to provide information on: a) efficacy of alternative spawning techniques, b) egg incubation and fry production techniques, c) holding and rearing densities, d) prophylactic treatments, e) nutritional requirements and feeding techniques, and f) optimal environmental rearing conditions and systems.

11. Establish stocking goals and success criteria prior to development of stock enhancement or recovery programs.

12. Conduct research to identify suitable fish sizes, and time of year for stocking cultured fish.

13. Conduct and monitor pilot-scale-stocking programs before conducting large-scale efforts over broad geographic areas.

14. Identify rates of tag loss and tag reporting.

15. Evaluate existing sea sampling data to characterize at-sea migratory behavior.

16. Establish tolerance of different life stages to important contaminants and levels of such environmental factors such as DO, pH, and temperature.

17. Standardize collection procedures and develop suitable long-term repository for biological tissues for use in genetic and other studies.

18. Develop the capability to capture wild broodstock and develop adequate holding and transport techniques for large broodstock.

19. Research should be conducted to identify the major pathogens of Atlantic sturgeon and a cell line for this species should be developed.

20. Conduct a cost benefit analysis of various stocking protocols.

21. Conduct further analyses to assess the sensitivity of F50 to model inputs.

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Stevenson, J.T., and D.H. Secor. 1999. Age determination and growth of Hudson River Atlantic surgeon, *Acipenser oxyrinchus*. Fish. Bull. 97:153-166.

Stevenson, J.T., 1997. Life history characteristics of Hudson River Atlantic sturgeon and an age-based model for management. M.S. Thesis, Univ. of Maryland, College Park, MD, 221p.

Waldman, J.R., and D.H. Secor. 1999. Caviar trade in North America: an historical perspective, pp. 52-64. In: D. Williamson (ed.), Proceedings of the Symposium on Harvest, Trade, and Conservation of North American sturgeon and Paddlefish.

Waldman, J.R., J.T. Hart, and I. I. Wirgin. 1996. Stock composition of the New York Bight Atlantic sturgeon fishery based on analysis of mitochondrial DNA. Trans. Am. Fish. Soc. 125:364-371.

Notes:

Ongoing work involving mtDNA is being completed by J. Waldman and J. Wirgin in order to determine the extent to which Atlantic sturgeon are genetically differentiable among rivers.

The Atlantic States Marine Fisheries Commission's Atlantic Sturgeon Fisheries Management Plan requires the monitoring of Atlantic sturgeon populations for trends, in the absence of directed fisheries.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Ph.D. candidate, Edwin Niklitschek is completing his dissertation research on "Identifying essential nursery habitat for Atlantic and shortnose sturgeons in the Chesapeake Bay".

Objectives of Edwin's research are to:

a) Develop bioenergetics models for juvenile shortnose and Atlantic sturgeon; predict individual consumption, growth and respiration rates as responses to temperature, dissolved oxygen, and salinity.
b) Based on species-specific bioenergetic models, predict trophic demand and potential production of juvenile Atlantic and shortnose sturgeons.
c) Using potential production estimates, evaluate spatial and temporal availability and quality of nursery habitats for both sturgeon species within Chesapeake Bay.
d) Integrating bioenergetics, feeding ecology, and behavior information, characterize niches for juveniles of each species and potential overlap between these niches.

Research Needs Identified As Being Met

Establish a tag recovery clearinghouse and database for consolidation and evaluation of tagging and tag return information including associated biological, geographic, and hydrographic data.

Black Sea Bass

Prioritized Research Needs

High Priority

Sampling should be increased for commercial landing in black sea bass fisheries, specifically the fish pot fisheries in the Mid-Atlantic. Age sampling should be increased across all components of the commercial fishery.

Sampling should be increased in the recreational fisheries. Age data should be collected from the total catch, and length sampling should be done to characterize size structure of discards.

Develop fishery independent surveys and expand existing surveys to capture all sizes and age classes in order to develop independent catch-at-age and CPUE.

Investigate the effect of sex transition rates, sex ratio and differential natural mortality by sex on the calculation of spawning stock biomass per recruit and eggs per recruit. Also, investigate the impact on reproduction of removal of large males from the population.

Studies on sex-specific mortality rates and growth are needed.

Increase sea sampling to verify information from commercial logbooks to provide better estimates of discards.

A tagging program should be initiated through state fisheries agencies to estimate mortality independent of traditional methods.

Further delineation of essential fish habitat (EFH), particularly in nursery areas. Further investigation of possible gear impacts on EFH.

Medium Priority

Explore alternative assessment models, including non-age based alternatives.

Consideration should be given to a pot survey for an index of abundance.

Identify transport mechanisms or behavior that move early juvenile black sea bass into estuaries.

Evaluate habitat use by overwintering yearling, young-of-the-year, and adult black sea bass.

Evaluate food habits of black sea bass larvae and overwintering adults.

Low Priority

Develop mariculture techniques.

A study determining the value of artificial reefs for increased production of black sea bass would be valuable in estimating potential yield.

List of References

Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission. 1998. Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass FMP. MAFMC. Dover, DE. 398 p. plus appendices.

Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

***Notes**:*

The New Jersey Department of Environmental Protection collects some commercial length frequency data for black sea bass and conducts a recreational harvest survey every four years.

The NMFS Northeast Fisheries Science Center is currently exploring alternative assessment models for black sea bass, including non-age based methods.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

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Bluefish

Prioritized Research Needs

1. Data needs:
   a) Sampling of size and age composition of the fisheries by gear type and statistical area should be increased.
   b) Commercial and recreational landings of bluefish should be targeted for biological data collection wherever possible.
   c) Increase intensity of biological sampling of the NER commercial and coastwide recreational fisheries.

2. Continue research on species interactions and predator/prey relationships.

   A scale-otolith age comparison study needs to be completed for bluefish.

3. Explore alternative methods for assessing bluefish, such as length-based and modified DeLury models.

4. Measures of CPUE under different assumptions of effective effort should be evaluated to allow evaluation of sensitivity of results.

5. Initiate fisheries dependent and independent sampling of offshore populations of bluefish during winter months.

6. Conduct research to determine the timing of sexual maturity and fecundity of bluefish.

7. Work should continue on catch and release mortality.

8. Any archived age data for bluefish should be aged and used to supplement North Carolina DMF keys in future assessments.

9. Conduct research on oceanographic influences on bluefish recruitment, including information on migratory pathways of larval bluefish.

10. Study tag mortality and retention rates for the American Littoral Society dorsal loop and other tags used for bluefish.

11. A coastal surf-zone seine study needs to be initiated to provide more complete indices of juvenile abundance.

12. Test the sensitivity of the bluefish assessment to assumptions concerning age-varying M, levels of age 0 discard, and the selection pattern.

13. Increase sampling frequencies when bluefish are encountered, especially when medium size fish are encountered.

14. Scientific investigations should be conducted on bluefish to develop an understanding of the long term, synergistic effects of combinations of environmental variables on various biological and sociological parameters such as reproductive capability, genetic changes, and suitability for human consumption.

15. Studies on the interactive effects of pH, contaminants, and other environmental variables on survival of bluefish.

16. Investigate the relationship of epidemic dermatological disease of bluefish exhibited in the Tar-Pamlico estuary to environmental toxics or other parameters.

17. Investigate the distribution of adult bluefish (particularly the spring-spawned cohort) in the South Atlantic Bight and juvenile bluefish (including the pelagic stage); and develop precise information on the distribution and relative abundance of bluefish in inshore areas, especially estuaries and embayments.

List of References

Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission. 1998. Amendment 1 to the Bluefish FMP. MAFMC. Dover, DE. 398 p. plus appendices.

Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

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Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Drs. Dave Secor and Ed Houde and their students are involved in a three-year project: "Estuarine and near-shore dependency of juvenile bluefish in Maryland's Chesapeake Bay and coastal zone (1998-2001) which is funded by NMFS through Rutgers Blue fish Research Program. Their research compares Chesapeake Bay, Delmarva coastal bays, and the coastal ocean as nursery areas for Y-O-Y bluefish.

Objectives of their research are to:

a) Evaluate essential components of juvenile bluefish nurseries; i.e., diets and feeding conditions, habitat structure, and water quality.

b) Determine if bluefish in the Chesapeake region preferentially use estuaries, coastal embayments, or the coastal ocean during the juvenile stage.

c) Investigate the origins, time of production, and habitat use..

Horseshoe Crab

Prioritized Research Needs

High Priority

Evaluate the effectiveness of currently used benthic sampling gear for stock assessment.

Medium Priority

Investigate larval and juvenile survival and mortality to assist in the assessment of annual recruitment.

Further evaluate life table information including sex ratio and population age structure.

Evaluate the effect of mosquito control chemicals on horseshoe crab populations.

Determine beach fidelity by horseshoe crabs to determine habitat use.

Evaluate the impacts of beach nourishment projects on horseshoe crab populations.

Evaluate the importance of horseshoe crabs to other marine resources such as sea turtles.

Estimate the proportion of sub-tidal spawning and determine if this effects spawning success (i.e. egg survivability).

Develop a young-of-year or age 1 recruitment index from the Delaware 16-foot trawl survey.

Conduct tagging studies (mark-recapture) to determine the incidence of repeated spawning and dispersal parameters.

Low Priority

Estimate fishing discard numbers and associated mortality rates.

Conduct additional stock assessments and determine harvest mortality rates (F). Use these data to develop a more reliable sustainable harvest rate.

Develop biological reference points (such as natural mortality rates, growth rates, fecundity, etc.).

List of References

Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

Notes:

Several high priority research needs are being currently being addressed, as follows:

Delaware Bay spawning beach survey:

a) Determine sampling frame or list of beaches in the Bay with a nonzero probability of being sampled in a given year.
b) Determine how many beaches need to be surveyed on how many days to meet survey objectives.
c) Determine whether subsampling effort (no. of quadrats per beach) was adequate.
d) Consider a survey design that includes both fixed and random beaches.

Delaware Bay egg count survey:

a) Set primary objective of egg count surveys to be shorebird food availability and focus on density of eggs at the surface (< 5cm).
b) Determine survey frequency (i.e., survey eggs annually, every 3 years, every 5 years, or other?).
c) Determine where, along the beach profile, eggs should be sampled.
d) Determine sample size for sampling eggs on a beach.
e) Determine the relationship between spawning activity and density of eggs at the surface (<5cm). Is there a threshold of spawning activity below which eggs remain buried and unavailable to shorebirds?

Biomedical and Atlantic coast horseshoe crab tagging program:

a) Clearly define objectives of the coastwide tagging program.
b) Evaluate and implement methods to increase reporting rate, especially among fishermen.
c) Compare tag types with the objective of minimizing entanglement, tag-induced mortality, and tag loss.

Offshore benthic survey, specifically for horseshoe crabs:

a) Clearly define objectives of offshore benthic survey.
b) Design comparative surveys or experiments to determine gear efficiencies.

Delineate horseshoe crab spawning and nursery habitats using the ASMFC Horseshoe Crab Habitat Delineation Guide.

Determine if regional horseshoe crab populations exist along the Atlantic coast.

a) Provide horseshoe crabs from throughout the Atlantic coast to the U.S. Geological Service to facilitate a project to develop species-specific microsatellite DNR loci of *Limulus polyphemus* to assess genetic diversity along the Atlantic coast.
b) Determine potential mixing between northern New Jersey (Sandy Hook/Jamaica Bay) and Delaware Bay because of the effect of harvest on Delaware Bay spawning.
c) Relate genetic variation to previously described morphometric variation.

Investigate, encourage, and fund alternative and synthetic bait sources for conch and eel fisheries.

Continue or initiate shorebird surveys using standardized methodologies to determine weight gain during stopovers, shorebird habitat use as it relates to horseshoe crab essential habitat (e.g., shorebird numbers as it relates to horseshoe crab egg densities), population trends, and if possible a population estimate.

Estimate mortality from the entire biomedical collection process, from capture to post-return.

Conduct economic studies to determine the value of the commercial fishery, biomedical, and ecotourism industries and the impact of regulatory management on these industries. Such economic studies should also include an assessment of economic impacts on other fisheries as they relate to horseshoe crabs.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Northern Shrimp

Prioritized Research Needs

1. Evaluate appropriate biological reference points and define sustainable harvest levels. The potential for improving estimates of mortality, abundance, and biomass from historical fishery and survey data from the 1960s should be investigated for further guidance on appropriate biological reference points.

2. Evaluate the stock recruitment relationship for northern shrimp.

3. Evaluate natural mortality, including relative impacts of predation and disease and variation at age and over time.

4. Evaluate larval growth and survival in response to environmental conditions.

5. Evaluate maturation, fecundity and lifetime spawning potential.

6. Evaluate growth, including frequency of molting and variation in growth rates as a function of environmental factors and population density.

7. Evaluate distribution of larval, juvenile, and adult shrimp. Evaluate migration and local movements.

8. Estimates of fecundity at length should be updated, and the potential for annual variability should be explored.

9. Investigate changes in transition and maturation as a function of stock size and temperature.

10. Evaluate competition and predator-prey relationships between species.

11. Continue sea-sampling efforts. Power analysis of estimates of mean weight from port sampling should be investigated to optimize sample design.

12. Improve separator and excluder devices to reduce bycatch and discard of non-targeted species. Explore gear modifications, such as larger mesh, to minimize shrimp bycatch in finfish trawl fisheries.

13. Characterize demographics of the fishing fleet by area and season; perform comparative analysis of fishing practices between areas.

14. Perform cost-benefit analyses to evaluate management measures.

15. Develop an understanding of product flow and utilization through the marketplace; identify performance indicators for various sectors of the shrimp industry.

16. Modify sea sampling protocol to characterize discards of shrimp in the shrimp trawl fishery and the small-mesh whiting fishery.

17. Efforts to quantify the magnitude of bycatch by species, area, and season should be continued and the steps necessary to limit negative impacts taken.

18. Evaluate vulnerability of shrimp to various fishing gear.

19. Develop a time series of standardized effort to corroborate patterns of estimated F.

20 Methods for age determination from length and ontogenetic stage information should be continued to develop the possibility of using age-based assessment methods.

21. Expand the time series of stock and recruitment data using catchability estimates from the production model.

List of References

Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

Notes:

Sea sampling effort to date has probably identified adequately the catch and bycatch in the shrimp fishery in the Gulf of Maine under current gear and season constraints. Until changes are made in gear and season, sea sampling may remain minimal. Research to improve on excluder devices to reduce bycatch is still a reasonable investment in that bycatch of small whiting and small flatfish is still a problem. Bycatch by species, area and season has been adequately quantified as long as the fishing season and gear remain generally the same. Limiting negative impacts is still a fairly important area of research focus.

Dunham and Muller at the University of Maine conducted an economic study of the shrimp fishery including the characterization of demographics of the fishing fleet by area and season in 1976. This study should be updated.

Some recent work has been done on the relative distribution of shrimp and juvenile groundfish along the Maine coast. Little is known of the distribution and/or life history of the juvenile stage of *P. borealis*, therefore the age structure of the population is less certain.

Migration of *P. borealis* is known to occur to a greater extent in the Gulf of Maine than anywhere else in the world. Several aspects of this migration remain an enigma.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Red Drum

Prioritized Research Needs

1. Support fishery-independent sampling of sub-adult and adult red drum in each state from North Carolina to Florida. The purpose of this survey would be to: 1) verify escapement to the spawning population, 2) provide an index of recruitment to age 1, and 3) provide an estimate of the biomass of adult red drum.

2. Develop a more reliable estimate of natural and fishing mortality through directed sampling of the adult population.

3. Determine habitat preferences, environmental conditions, growth rates, and food habits of larval and juvenile red drum throughout the species range along the Atlantic coast. Assess the effects of environmental factors on stock density.

4. Identify spawning areas of red drum in each state from North Carolina to Florida so these areas may be protected from degradation and/or destruction. Determine the impacts of dredging and beach re-nourishment on red drum spawning and early life history stages.

5. Continue tagging studies to determine stock identity, inshore/offshore migration patterns and mortality estimation.

6. Determine the survival rate of red drum following regulatory and voluntary discard from commercial and recreational gear, including recreational net fisheries. Evaluate effects of water temperature and depth of capture.

7. Improve catch/effort estimates and biological sampling from recreational and commercial fisheries for red drum, including increased efforts to intercept night-time fisheries for red drum by the NMFS MRFSS. Characterize magnitude of commercial and recreational discards.

8. States with significant fisheries should be encouraged to collect socio-economic data on red drum fisheries through add-ons to the MRFSS or by other means so as to determine the economic value of the Atlantic coast recreational red drum fishery.

9. Quantify relationships between red drum production and habitat.

10. Investigate and evaluate new stock assessment techniques as alternatives to age-structured models. Conduct yield modeling on red drum.

11. Investigate the concept of estuarine reserves to increase the escapement rate of red drum along the Atlantic coast.

12. Fully evaluate the efficacy of using cultured red drum to restore native stocks along the Atlantic coast, including cost-benefit analyses.

13. Identify the effects of water quality degradation on the survival of red drum eggs, post-larvae, larvae, and juveniles.

14. Refine maturity schedules on a geographic basis, determine relationships between annual egg production over a range of sizes, ages and across latitude.

15. Determine methods for restoring red drum habitat and/or improving existing environmental conditions that adversely affect red drum production.

16. Document and characterize schooling behavior for Atlantic coast red drum.

Scup

Prioritized Research Needs

High Priority

Increased and more representative sea sampling of the various fisheries in which scup are caught (both as a targeted and non-targeted species) is needed to adequately characterize the length composition of discards. A pilot study to develop a sampling program to estimate discards should be implemented.

Studies to better characterize the mortality of scup in different gear types should be conducted to more accurately assess discard mortality. Including additional information on hooking mortality is needed to interpret recreational discard data.

A study to develop optimum sampling levels to estimate discards should be implemented. This would quantify the advantages to obtaining sea samples from freezer trawlers and other small mesh fleets from which few samples have been collected, and would provide an opportunity for joint industry research programs.

Commercial discard mortality had previously been assumed to be 100% for all gear types. The committee recommends that studies be conducted to better characterize the mortality of scup in different gear types to more accurately assess discard mortality.

Develop fishery independent surveys and expand existing surveys to capture all sizes and age classes in order to develop independent catch-at-age and CPUE.

Expand age sampling of scup from commercial and recreational catches, with special emphasis on collection of large specimens.

Further delineation of essential fish habitat (EFH) particularly in nursery areas. Further investigation for possible gear impacts on EFH.

Commercial LPUE data should be investigated as a possible tuning index for scup, including spatial variations and confounding effects.

Medium Priority

Continue studies on the importance of factors controlling the production and distribution of food items that appear in the diet of young scup.

Low Priority

Conduct research on the trophic relationships of scup.

It is necessary that scientific investigations be conducted on scup to emphasize the long term, synergistic effects of combinations of environmental variables on, for example, reproductive capability, genetic changes, and suitability for human consumption.

Conduct studies on the interactive effects of pH, contaminants, and other environmental variables on survival of scup.

Further biological studies are needed to look at factors affecting annual availability of scup to research surveys and maturity schedules.

Given the low number of age groups represented in the present catch-at-age matrix for scup, as well as the uncertainty associated with the age compositions of catches, primarily the discarded portion, consideration should be given to the future use of non-age-based assessment methods (*e.g.* DeLury).

Explore alternative methodologies for analyzing the available sea sampling data.

Explore sensitivity of YPR reference points to changes in input parameters.

Explore other assessment approaches, including Bayesian and bootstrap techniques that incorporate uncertainty in catch estimates. Explore models that incorporate within-year survey data.

A comprehensive database should be maintained that includes all available data from the scup commercial and recreational fishery, research surveys, and sea and port sampling programs, with timely updates from participating agencies.

Summaries of research recommendations should be forwarded to the NRCC for review and comment, followed by a feasability analysis. At that point, a list of priorities and perhaps assignments for research could be made. The SARC recommends that a working group be developed to assess what group would be best suited to address each research need.

Investigate the statistical properties of the three commercial discard estimation approaches presented for consideration in future analyses.

Quantify the percentage of commercial fishery trips that had discards but no landings, and evaluate how such trips contribute to the total commercial fishery discard estimate.

Continue exploration of relative biomass and relative exploitation calculations based on CPUE data from the recreational private boat fishery.

Explore approaches for analyzing survey data, including bootstrap resampling methods to generate approximate confidence intervals around the survey index point estimates.

In the absence of reliable estimates of the catch, consideration should be given to simple forward projection models that rely on trends from the survey indices in the absence of catch information.

Design an optimal sampling plan that would be considered for implementation by the fishery observer sampling, recreational and commercial port sampling program.

Explore alternative biomass indices for development of biomass proxies for reference point determination based on multiple survey indices. ,

Evaluate the current biomass reference point and consider alternative proxy reference points such as B_{MAX} (the relative biomass associated with F_{MAX}).

Surveys should be evaluated to test the assumption of equal catchability at age in projections (*i.e.* through forward projection methods).

Explore alternative decision support methodologies for updating TALs directly from relative trends in abundance without relying on direct estimates of F.

List of References

Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission. 1998. Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass FMP. MAFMC. Dover, DE. 398 p. plus appendices.

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Spanish Mackerel

Prioritized Research Needs

High Priority

Length, sex, age, and CPUE data are needed to improve the stock assessment accuracy. Simulations on CPUE trends should be explored and impacts on VPA and assessment results determined. Data collection is needed for all states, particularly those north of North Carolina.

Weight and especially length at age of Spanish mackerel needs to be evaluated.

Develop fishery independent methods of monitoring stock size of Atlantic Spanish mackerel (consider aerial surveys used in south Florida waters).

More timely reporting of mid-Atlantic catches is needed for quota monitoring.

Provide better estimates of recruitment, natural mortality rates, fishing mortality rates, and standing stock. Specific information should include an estimate of total amount caught and distribution of catch by area, season, and type of gear.

Methodology for predicting year class strength should be developed, and the relationship between larval abundance and subsequent year class strength should be examined and defined.

Medium Priority

Yield per recruit analyses need to be conducted relative to alternative selective fishing patterns.

Determine the bycatch of Spanish mackerel in the directed shrimp fishery in Atlantic coastal waters.

Evaluate the potential bias of the lack of appropriate stratification of the data used to generate age-length keys for Atlantic and Gulf Spanish mackerel.

Evaluation of CPUE indices related to standardization methods and management history, with emphasis on greater temporal and spatial resolution in estimates of CPUE.

Encourage the consideration of MRFSS add-ons or other mechanisms for collection of socioeconomic data for recreational and commercial fisheries.

Conduct migration studies to determine normal Spanish mackerel migration routes and changes therein, and the climatic or other factors responsible for changes in the

environmental and habitat conditions which may affect the habitat and availability of stocks.

Determine the relationship, if any, between migration of prey species (engraulids, clupeids, carangids), and migration patterns of the Spanish mackerel stock.

Low Priority

Identification of Spanish mackerel stocks through multiple research techniques needs to be completed.

Research needs to be completed on the application of assessment and management models relative to dynamic species such as Spanish mackerel.

Temporal and spatial sampling to delineate spawning areas and areas of larval abundance should be initiated.

Spiny Dogfish

Prioritized Research Needs

Research and Data Needs
Biological

Standardize age determination along the entire East coast.

Genetic analysis of spiny dogfish to determine if more than one unit stock exist along the Northwest Atlantic.

Determine coastwide discard mortality rate for fixed and mobile gear fisheries that catch dogfish as bycatch.

Increase observer trips to document the level of incidental capture of spiny dogfish during the spawning stock rebuilding period.

Additional analyses of sea sampling data since 1994.

Further analyses of the commercial fishery is also warranted, especially with respect to the effects of gear types, mesh sizes, and market acceptability on the mean size of landed dogfish.

Increase the biological sampling of dogfish on research trawl surveys and in the commercial fishery.

Update maturation and fecundity estimates by length class.

Recover and encode information on the sex composition prior to 1980 from the survey database.

Review surveys to decide if mid-water trawling surveys should be included with bottom surveys to increase biological sampling of dogfish.

Continue work on the change-in-ratio estimators for mortality rates and suggest several options for analyses.

Analyze the effects of environmental conditions on survey catch rates.

Social
Update on a regular basis the characterization of fishing communities involved in the spiny dogfish fishery, including the processing and harvesting sectors, based upon Hall-Arber et al. (2001) and McCay and Cieri (2000).

Economic
Characterize the value and demand for spiny dogfish in the biomedical industry on a state by state basis.

Develop procedures for evaluating alternative opportunities and the mortality impacts that result from this switching to alternative opportunities behavior. Use Multinomial logit and random utility models to provide information on future trip limit analyses and expand upon Steinback and Thunberg's (2002) trip limit analysis. Trip limit cost estimates should be corroborated through industry advisor input or through other sources of data. Sensitivity analyses of Steinback and Thunberg's (2002) analysis should be conducted in the future to determine the range of possible outcomes.

Characterize the spiny dogfish processing sector.

Monitor the changes to the foreign export markets for spiny dogfish, and evaluate the potential to recover lost markets or expand existing ones.

Management

Characterize and quantify bycatch of spiny dogfish in other fisheries.

Monitor the level of effort and harvest in other fisheries as a result of no directed fishery for spiny dogfish.

Quantify effort directed on spiny dogfish in waters outside of the U.S.

Spot

Prioritized Research Needs

High Priority

In trawl fisheries or other fisheries that take significant numbers of spot, states should monitor and report on the extent of unutilized bycatch and fishing mortality on fish less than age-1. Incorporate bycatch estimates into spot assessment models.

The effects of mandated bycatch reduction devices (BRD's) on spot catch should be evaluated in those states with significant commercial harvests.

Fishery dependent and independent size and sex specific relative abundance estimates should be developed.

Cooperative coastwide spot juvenile indices should be developed to clarify stock status.

Monitor long term changes in spot abundance, growth rates, and age structure.

Continue monitoring of juvenile spot populations in major nursery areas.

Improve spot catch and effort statistics from the commercial and recreational fisheries, along with size and age structure of the catch, in order to develop production models.

Criteria should be cooperatively developed for aging spot otoliths and scales, and an age validation study should be conducted.

Medium Priority

A yield per recruit analysis should be cooperatively developed.

Develop stock identification methods.

Determine migratory patterns through tagging studies.

Determine the onshore vs. offshore components of the spot fishery.

Spotted Seatrout

Prioritized Research Needs

High Priority

Stock assessments should be conducted to determine the status of stocks relative to the plan objective of maintaining a spawning potential of at least 20%.

Initiate fishery independent surveys of spotted seatrout.

Emphasis should be placed on collecting the necessary biological data to be able to conduct stock assessments and to assist in drafting fishery management plans.

Age structure analyses by sex should be utilized in stock assessments.

Medium Priority

MRFSS should be expanded to assure adequate data collection for catch and effort data and for increased intercepts and state add-ons of social and economic data needs.

Identify essential habitat requirements.

Evaluate effects of environmental factors on stock density.

Work should be continued to examine the stock structure of spotted seatrout on a regional basis, with particular emphasis on molecular techniques.

Collection of commercial and recreational landings data should be continued and expanded. DATA

Collection of social and economic aspects of the spotted seatrout fishery should be initiated.

Improve precision of effort reporting through commercial trip ticket programs.

List of References

Muller, R. G., and M. D. Murphy. 1995. A stock assessment of spotted seatrout, *Cynoscion nebulosus*. Florida Dept. of Env. Prot., Florida Mar. Res. Inst., St. Petersburg, FL.

Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

Notes:

Florida Department of Environmental Protection developed a spotted seatrout stock assessment in January 1995 that addressed by sex yield modeling, spawning potential ratios, use of fishery independent monitoring to tune virtual population models.

Commercial effort is collected through Florida's Marine Fisheries Information System (Trip Tickets).

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Extuarine Exosystems (TIES): http://www.chesapeake.org/ties/).

Summer Flounder

Prioritized Research Needs

High Priority

Monitor abundance of juvenile summer flounder on a yearly basis.

The NEFSC domestic sea sampling program should continue the collection of data for summer flounder, with special emphasis on a) improved areal and temporal coverage, b) adequate length and age sampling, and c) continued sampling after commercial fishery areal and seasonal quotas are reached and fisheries are limited or closed.

Encourage research to determine the length and age frequency and discard mortality rates of commercial and recreational fishery summer flounder discards.

Investigate the source of bias in estimating terminal parameters of the VPA (fishing mortality and stock size). Partially addressed in SARC 25 assessment.

Undertake research to determine hooking mortality on summer flounder by circle, kahle, and regular "J" hooks and make the results of work already completed available to the Management Board.

Develop fishery independent surveys and expand existing surveys to capture all sizes and age classes in order to develop independent catch-at-age and CPUE.

Further delineation of essential fish habitat (EFH) particularly in nursery areas. Further investigation of possible gear impacts on EFH.

Collect and analyze age/length samples and catch/effort data from the commercial and recreational fisheries throughout the range of summer flounder.

Medium Priority

Develop a consistent and accurate sampling program to determine the mesh selectivity for summer flounder and other commercial fisheries taken in mixed fisheries, and to determine discard mortality.

Conduct a detailed socio-economic study of the summer flounder fisheries.

Research directed at evaluating the mesh exemption program should be continued, with increased sample sizes to allow reliable statistical testing of results.

Continue research to determine if the maturity ogive accurately reflects spawning potential of summer flounder.

Investigate allocation of NEFSC sea sampling trips to optimize sampling effort.

Develop stock identification methods via meristics, morphometrics, biochemical research and tagging; particularly off Virginia and North Carolina.

Develop fish excluder devices to reduce bycatch of immature flatfish in fisheries that target species other than flounder.

Low Priority

Develop a standardized index of abundance from NEFSC sea sampling data to provide a commercial fishery index that accounts for all removals by the fishery.

Investigate the utility of alternative strata sets for the NEFSC spring trawl survey time series for summer flounder.

Develop information on optimum length/age at capture and optimum mesh size.

Conduct the basic research necessary to develop land and pen culture techniques.

Evaluate effects of dissolved oxygen and water current requirements for adult summer flounder and summer flounder eggs.

Evaluate the relationship between recruitment of summer flounder to nursery areas and Ekman transport or prevailing directions of water flow.

List of References

Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission. 1998. Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass FMP. MAFMC. Dover, DE. 398 p. plus appendices.

Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

Notes:

The Atlantic Coastal Cooperative Statistics Program (ACCSP) is conducting a four-year pilot study for the collection of social and economic data on commercial harvesters. This pilot study is using the summer flounder permit system as the sampling frame and should, therefore, collect information relevant to the summer flounder fishery.

SARC-25 partially addressed the investigation of sources of bias in estimating terminal parameters of the VPA (fishing mortality and stock size).

The University of Rhode Island is undertaking research to determine if the maturity ogive accurately reflects spawning potential of summer flounder. The Management Board will be briefed on the results of this study.

SARC-20 partially addressed the Investigation of allocation of NEFSC sea sampling trips to optimize sampling effort.

SARC-22 partially addressed the development of a standardized index of abundance from NEFSC sea sampling data to provide a commercial fishery index that accounts for all removals by the fishery.

Work is in progress by private sector and universities to conduct the basic research necessary to develop land and pen culture techniques.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Tautog

Prioritized Research Needs

1. Establish standardized state-by-state long-term fisheries independent surveys to monitor tautog abundance and length-frequency distributions, and to develop young-of-the-year indices.

2. Initiate biological sampling of the commercial catch for each gear type over the entire range of the stock (Including weight, lengths, age, sex, and discards).

3. Collect effort data for determining commercial and recreational CPUE.

4. Explore possible regional and local genetic differences (stock differentiation) and relate these to recruitment, growth, exploitation rates, and habitat differences. These differences can help support appropriate region-specific management strategies.

5. Sample hard parts for annual aging from the catches of recreational and commercial fisheries and fishery-independent surveys throughout the range of the stock.

6. Define the status (condition and extent) of optimum or suitable juvenile habitats and trends in specific areas important to the species. It is critical to protect these habitats or to stimulate restoration or enhancement, if required.

7. Increase length sampling from the recreational fishery for all states from Massachusetts through Virginia.

8. Define the susceptibility of juveniles to coastal/anthropogenic contamination and resulting effects. This information can explain differences in local abundance, movements, growth, fecundity, and serve to support continued or increased regulation of the inputs of these contaminants and to assess potential damage. Since oil spills seem to be a too frequent coastal impact problem where juvenile tautog live, it may be helpful to conduct specific studies on effects of various fuel oils and typical exposure concentrations, at various seasonal temperatures and salinities. Studies should also be conducted to evaluate the effect of common piling treatment leachates and common antifouling paints on young of the year tautog. The synergistic effects of leaked fuel, bilge water, treated pilings, and antifouling paints on tautog health should also be studied.

9. Define the specific spawning and pre-spawning aggregating areas and wintering areas of juveniles and adults used by all major local populations, as well as the migration routes used by tautog to get to and from spawning and wintering areas and the criteria or times of use. This information is required to protect these areas from damage and overuse or excessive exploitation.

10. Define local and regional movement patterns and site fidelity in the southern part of the species range. This information may provide insights into questions of aggregation vs.

recruitment to artificial reef locations.

11. Define the source of offshore eggs and larvae (in situ or washed out coastal spawning).

12. Confirm that tautog, like cunner, hibernate in the winter, and in what areas and temperature thresholds, for how long, and are there special habitat requirements during these times that should be protected or conserved from damage or disturbance. This information will aid in understanding behavior variability and harvest availability.

13. Define the role of prey type and availability in local juvenile/adult population dynamics over the species range. This information can explain differences in local abundance, movements, growth, fecundity, etc. Conduct studies in areas where the availability of primary prey, such as blue mussels or crabs, is dependent on annual recruitment, the effect of prey recruitment variability as a factor in tautog movements (to find better prey fields), mortality (greater predation exposure when leaving shelter to forage open bottom), and relationship between reef prey availability/quality on tautog condition/fecundity.

14. Determine pot and trap escape vent dimensions needed to release tautog over a range of sizes.

List of References

Lucy, J., C. Bain III, and M. Arendt. 1999 Virginia Game Fish Tagging Program Annual Report, 1998. Virginia Mar. Res. Rpt. No. 99-B.

Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

Studies in conservation engineering. In A Study of Marine Recreational Fisheries in Connecticut, pp. 91-97. Connecticut Department of Environmental Protection, Marine Fisheries Office, Old Lyme, CT.

Steimle, F., and P. Shaheen. 1999. Tautog (*Tautoga onitis*) Life History and Habitat Requirements. NOAA Tech. Memo. NMFS-NE-118.

White, G. G. 1996. Reproductive Biology of Tautog, *Tautoga onitis*, in the Lower Chesapeake Bay and Coastal Waters of Virginia. M.S. Thesis. The College of William and Mary. 100 p.

White, G. G. 1997. Quantitative Assessment of Fishing Mortality for Tautog (*Tautoga onitis*) in Virginia. Virginia Marine Resources Commission. RF-96-11,51p.

***Notes**:*

Virginia conducted a volunteer recreational survey in 1994. The report contains information on abundance and length frequency data, Virginia Marine Resources Commission, Newport News, Virginia.

Jon Lucy and Claude Bains have conducted studies on the mortality of fish hooked and released in Virginia. More information can be obtained by contacting the Virginia Institute of Marine Science, Gloucester Point, Virginia. They also initiated the Virginia Game Fish Tagging Program in 1995, which, has to date tagged over 3,000 tautog. More information can be obtained from the Virginia Marine Resources Commission, Newport News, Virginia.

Massachusetts Division of Marine Fisheries has applied to the U.S. Fish and Wildlife Service for Wallop/Breaux funding to biologically sample and age tautog at two optional levels: 1) to contribute to a regional age/length key, and 2) to collect sufficient samples to create a state age/length key.

Connecticut Department of Environmental Protection is conducting ongoing research to determine hook and release mortality of tautog.

Annual aging studies are being conducted at some level in all states from Massachusetts through

Virginia. New Jersey has sampled fish for aging from 1993 through the present. In September 1997, the Virginia Marine Resources Commission established a fish-aging laboratory in cooperation with Old Dominion University to analyze ages of Virginia's commercial finfish species. Annual tautog aging studies began in 1998.

Spawning locations (specific) may be known for Rhode Island, Connecticut, New York, Delaware. In Virginia, specific spawning locations and areas are known. Wintering habitats of juveniles (0-3 years) known in all states. Migration routes (possible) are known based on tagging.

Define local and regional movement patterns and site fidelity in the southern part of the species range. This information may provide insights into questions of aggregation vs. recruitment to artificial reef locations. This work is currently being conducted as a Master's Thesis at the Virginia Institute of Marine Science.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Weakfish

Prioritized Research Needs

High Priority

Collect catch and effort data including size and age composition of the catch, determine stock mortality throughout the range, and define gear characteristics. In particular, increase length-frequency sampling, particularly in fisheries from Maryland and further north.

Develop latitudinal / seasonal / gear specific age length keys for the Atlantic coast. Increase sample sizes to consider gear specific keys.

Derive estimates of discard mortality rates and the magnitude of discards for all commercial gear types from both directed and non-directed fisheries. In particular, quantify trawl bycatch, refine estimates of mortality for below minimum size fish, and focus on factors such as distance from shore and geographical differences. Update the scale – otolith comparison for weakfish.

Medium Priority

Define reproductive biology of weakfish, including size at sexual maturity, maturity schedules, fecundity, and spawning periodicity. Continue research on female spawning patterns: what is the seasonal and geographical extent of "batch" spawning; do females exhibit spawning site fidelity?

Conduct hydrophonic studies to delineate weakfish spawning habitat locations and environmental preferences (temperature, depth, substrate, etc.) and enable quantification of spawning habitat.

Compile existing data on larval and juvenile distribution from existing databases in order to obtain preliminary indications of spawning and nursery habitat location and extent.

Continue studies on mesh-size selectivity; up-to-date (1995) information is available only for North Carolina's gill net fishery. Mesh-size selectivity studies for trawl fisheries are particularly sparse.

Assemble socio-demographic-economic data as it becomes available from ACCSP.

Additional investigation is needed in developing consistent otolith-based catch matrices including the EM algorithm.

The impact of aging errors and other statistical uncertainties in the catch-at-age matrix on virtual population analysis (VPA) should be included. Retrospective analyses are needed on all VPA approaches investigated.
Develop a spawner recruit relationship and examine the relationships between parental

stock size and environmental factors on year-class strength.

Low Priority

Identify stocks and determine coastal movements and the extent of stock mixing, including characterization of stocks in overwintering grounds. (e.g. tagging).

Biological studies should be conducted to better understand migratory aspects and how this relates to observed trends in weight at age.

Continue studies on recreational hook-and-release mortality rates, including factors such as depth, warmer water temperatures, and fish size in the analysis. Further consideration of release mortality in both the recreational and commercial fisheries is needed, and methods investigated to improve survival among released fish.

Document the impact of power plants and other water intakes on larval, post larval and juvenile weakfish mortality in spawning and nursery areas, and calculate the resultant impact to adult sock size.

Define restrictions necessary for implementation of projects in spawning and overwintering areas and develop policies on limiting development projects seasonally or spatially.

Determine the onshore versus offshore components of the weakfish fishery.

Develop a coastwide tagging database.

Develop a spawner recruit relationship and examine the relationships between parental stock size and environmental factors on year-class strength.

List of References

Crawford, M. K., C. B. Grimes, and N. E. Buroker. 1989. Stock identification of weakfish, *Cynoscion regalis*, in the Middle Atlantic Region. Fish. Bull., U.S. 87:205-211.

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Nesbit, R. A. 1954. Weakfish migration in relation to its conservation. U.S. Fish Wildl. Serv. Spec. Sci. Rep. 115, 81 p.

Scoles, D. 1990. Stock identification of weakfish, *Cynoscion regalis*, by discriminant function analysis of morphometric characteristics. M.S. Thesis, College of William and Mary, Williamsburg, 51 p.

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Shepherd, G. R., and C. B. Grimes. 1984. Reproduction of weakfish, *Cynoscion regalis*, in the New York Bight and evidence for geographically specific life history characteristics. Fish. Bull., U.S. 82: 501-511.

Shepherd, G. R., and C. B. Grimes. 1983. Geographic and historic variations in growth of weakfish, *Cynoscion regalis*, in the middle Atlantic Bight. Fish. Bull., U.S. 81: 803-813.

Villoso, E. P. 1989. Reproductive biology and environmental control of spawning cycle of weakfish, Cynoscion regalis (Block and Schneider) in Delaware Bay. Ph.D. Dissertation, Univ. of Delaware, Newark, DE.

Notes:

The identification of stocks and determination of coastal movements and the extent of stock mixing, including characterization of stocks in overwintering grounds; is partially being addressed by Charlie Wenner, SC, through a MARFIN grant.

Gary Swihart has conducted studies on hook-and-release mortality in cool and warm water temperatures, and release mortality from a commercial pound net.

The definition of reproductive biology of weakfish, including size at sexual maturity, fecundity, and spawning periodicity. The research on female spawning patterns: what is the seasonal and geographical extent of "batch" spawning; do females exhibit spawning site fidelity? Is Being addressed by EFH initiative.

The compilation of existing data on larval and juvenile distribution from existing databases in order to obtain preliminary indications of spawning and nursery habitat location and extent, is partially being addressed by Charlie Winner, SC, through a MARFIN grant

The study of the north-south gradient in weakfish growth rates, is partially being addressed by Charlie Wenner, SC, through a MARFIN grant.

The development of a coastwide tagging database is being developed through ASMFC.

The ASMFC's Weakfish Stock Assessment Committee is currently conducting sensitivity analyses on current state and federal fishery dependent and independent monitoring programs to determine which, if any, may be eliminated. Programs determined essential will be used to improve a coastwide virtual population analysis model. Further evaluation of assessment models best suited for weakfish should continue.

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Research Needs Identified as Being Met

Study the north-south gradient in weakfish growth rates.

The study of the north-south gradient in weakfish growth rates, is partially being addressed by Charlie Wenner, SC, through a MARFIN grant.

Monitor long-term changes in abundance, growth rates, and age structure.

Winter Flounder

Prioritized Research Needs

Coastwide

1. Expand sea sampling for estimation of commercial discards.

2. Conduct gear study to determine selectivity of diamond and square mesh sizes 6 inches on winter flounder (and other groundfish species).

3. Focus research on quantifying mortality associated with habitat loss and alteration, contamination by toxics and power plant entrainment and impingement.

4. Research studies should be designed to provide reliable estimates of anthropogenic mortality from sources other than fishing. Both mortality sources should then be incorporated into fisheries yield/recruit models to simultaneously evaluate these dual mortality factors.

5. Conduct studies of flounder populations in impacted areas to fully quantify physiological adaptation to habitat alteration, and interactive effects, on an individual and population level.

Southern New England - Mid-Atlantic Stock Complex

1. Maintain or increase sampling levels and collect age information from MRFSS samples.

2. Expand sea sampling for estimation of commercial discards.

3. Develop a geographically more comprehensive data set to calculate maturity at age, reflecting any differential availability of mature fish to inshore and offshore surveys. Re-examine the maturity ogive to incorporate any recent research results.

4. Conduct studies to delineate all major substocks in terms of geographic spawning area and seasonal offshore movements (e.g. exposure to fishing pressure).

5. Further examine the comparability of age length keys from different areas within the stock (current comparisons are based on two years and three ages). Conduct an age structure comparison between NEFSC, CT DEP and MADMF, to ensure consistency in ageing protocol (work in progress).

6. Examine the implications of stock mixing from data from the Great South Channel region.

7. Compile NEFSC Winter Survey abundance indices for winter flounder and evaluate their activity.

8. Evaluate the utility of MA DMF sea sample data for winter flounder.

9. Revise the recreational fishery discard estimates by applying a consistent method across all years, if feasible (i.e., the Gibson 1996 method).

10. Age archived MA DMF survey age samples for 1978-1989.

11. Examine the implications of anthropogenic mortalities caused by pollution and power plant entrainment in estimation of yield per recruit, if feasible.

12. Estimate/evaluate effects of catch-and-release components of recreational fishery on discard at age (i.e. develop mortality estimates from the American Littoral Society tagging database, if feasible).

13. Explore the feasibility of stratification of commercial fishery discard estimation by fishery (e.g., mesh, gear, area).

Gulf of Maine Stock

<u>High Priority</u>

Process archived age samples from surveys and commercial landings, and develop analytical age based assessment.

Improve sampling for biological data (particularly hard parts for ageing) of commercial landings of winter flounder.

Expand sea sampling in order to validate commercial discard estimates from Vessel Trip Reports (logbooks).

Maintain or increase sampling levels and collect age information from MRFSS samples.

Update age-based biological reference points for the GOM stock and examine other biological reference points and rebuilding strategies in projection models.

Update or conduct regional maturity studies. This may require a maturity workshop to ensure the use of standardized criteria among regional studies.

Evaluate size-selectivity performance of survey gear compared to typical commercial gear, and implications for estimation of commercial discards from research survey length frequency information.

Evaluate the feasibility of virtual population analysis based only on ages fully recruited to landings (i.e. no discards).

<u>Medium Priority</u>

Examine growth variations within the Gulf of Maine, using results from the Gulf of Maine Biological Sampling Survey (1993-94).

Evaluate effects of smoothed length-frequency distributions on the relationship between survey and commercial catches at length.

Low Priority

Further examine the stock boundaries to determine if Bay of Fundy winter flounder should be included in the Gulf of Maine stock complex.

Estimate/evaluate effects of catch-and-release components of recreational fishery on discard at age.

List of References

Secor, D.H., and J.R. Rooker. 2000. Is otolith strontium a useful scalar of life cycles in estuarine fish? Fisheries Res. 46: 359-371.

Notes:

Dave Secor of Chesapeake Biological Laboratory has data on American eel, American shad, and striped bass; literature review of American shad, striped bass, American eel, and red drum, and many other spp.

Drs. Tom Miller and Ed Houde have a new CBSAC (Chesapeake Bay Stock Assessment Committee) project to develop multispecies fish surveys in the Bay by synthesizing Trophic Interactions in Estuarine Ecosystems (TIES): http://www.chesapeake.org/ties/).

Research Needs by Topic

STOCK ASSESSMENT RELATED ISSUES

STOCK ASSESSMENT RELATED ISSUES

Analytical Issues

American Lobster

Methods should be developed to derive standardized catch-per-unit-effort indices which include trap attributes, season, soak time, etc. Sea sampling should be modified to include collection of potentially important variables.

Explore alternatives to timing of events in the EPR model. Investigate geographic and seasonal patterns of growth, reproductive events, and fishing intensity from catch and sea sampling data. Standardize methods of sampling and statistical analysis are needed to determine these patterns.

Additional analyses of biological attributes of the catch and survey data are needed to corroborate patterns and trends in F estimates.

Undertake regional examination of temperature-yield relationship. (Estrella, Bruce, and Steven Cadrin. 1991. Massachusetts coastal commercial lobster trap sampling program, 1990 Annual Report. 52 pp.; Fogarty, Michael J. 1988. Time series models of Maine lobster fishery: Effects of temperature. Canadian Journal of Fisheries and Aquatic Sciences, Volume 45, 1145-1153.)

Examine temperature, effort, and abundance effects on catch.

Use comparative evaluations of reproductive rates with respect to temperature.

Compare fishery-dependent and fishery-independent length frequencies. (Completed through stock assessment process but no formal document.)

Develop a time series of standardized fishing effort and compare with F.

Examine spatial differences in F (10%) in the egg production per recruit model.

Evaluate potential biases in the Delury analysis due to incomplete coverage in different substrates.

Establish field studies of density-dependent processes. (Bob Steneck in progress.)

Atlantic Croaker

Age-length keys that are representative of all gear types in the fishery should be developed.

Cooperatively develop a yield per recruit analysis to establish a minimum size that maximizes YPR.

Atlantic Menhaden

Monte Carlo simulations should be conducted to evaluate precision of VPA.
Determine the effects of regulations on the fishery, the participants and the stock.

Atlantic Sea Herring

Reinvestigate the estimation of age-3 herring, investigate the natural mortality rate assumed for all ages, the use of catch-per-unit-effort tuning indices, and the use of NEFSC fall bottom trawl survey tuning indices in the analytical assessment of herring.

Develop new approaches to estimating recruitment (i.e. juvenile abundance) from fishery-independent data.

Consider using NEFSC fall survey mean weights at age as the spawning stock mean weight at age in the estimation of biological reference points. Evaluate alternative catch weights at age.

Investigate alternative methods of estimating mean weight at age used to determine the age composition of U.S. and Canadian landings from the coastal stock complex.

Conduct a retrospective analysis of herring larval and assessment data to determine the role larval data plays in anticipating stock collapse and as a tuning index in the age-structured assessment.

Potential changes in catchability within spring bottom trawl survey indices should be investigated.

Investigate the effects of averaging maturity rates over blocks of years to help smooth some of the interannual variability in the calculation of spawning stock biomass.

Possible effects of density-dependence (e.g. reduced growth rates at high population size) on parameter estimates used in assessments should be examined.

Atlantic Striped Bass

Conduct sensitivity analysis on current state and federal fishery dependent and independent monitoring programs to determine which, if any, may be eliminated.

Quota calculation methods should be refined which allow better estimates among various components of the fishery.

Examine differential reporting rates between commercial and recreational fishermen using high reward tags.

Atlantic Sturgeon

Characterize size, condition, and relative abundance of Atlantic sturgeon by gear and season taken as bycatch in various fisheries.

Atlantic Sturgeon

Conduct further analyses to assess the sensitivity of F50 to model inputs.

Bluefish

Measures of CPUE under different assumptions of effective effort should be evaluated to allow evaluation of sensitivity of results.

Test the sensitivity of the bluefish assessment to assumptions concerning age-varying M, levels of age 0 discard, and the selection pattern.

Horseshoe Crab

Estimate fishing discard numbers and associated mortality rates.

Northern Shrimp

Evaluate the stock recruitment relationship for northern shrimp.

Develop a time series of standardized effort to corroborate patterns of estimated F.

Further evaluate life table information including sex ratio and population age structure.

Expand the time series of stock and recruitment data using catchability estimates from the production model.

Continue sea-sampling efforts. Power analysis of estimates of mean weight from port sampling should be investigated to optimize sample design.

Characterize demographics of the fishing fleet by area and season; perform comparative analysis of fishing practices between areas.

Red Drum

Investigate and evaluate new stock assessment techniques as alternatives to age-structured models. Conduct yield modeling on red drum.

Scup

Commercial LPUE data should be investigated as a possible tuning index for scup, including spatial variations and confounding effects.

Further biological studies are needed to look at factors affecting annual availability of scup to research surveys and maturity schedules.

Explore alternative methodologies for analyzing the available sea sampling data.

Explore sensitivity of YPR reference points to changes in input parameters.

Investigate the statistical properties of the three commercial discard estimation approaches presented for consideration in future analyses.

Quantify the percentage of commercial fishery trips that had discards but no landings, and evaluate how such trips contribute to the total commercial fishery discard estimate.

Continue exploration of relative biomass and relative exploitation calculations based on CPUE data from the recreational private boat fishery.

Explore approaches for analyzing survey data, including bootstrap resampling methods to generate approximate confidence intervals around the survey index point estimates.

In the absence of reliable estimates of the catch, consideration should be given to simple forward projection models that rely on trends from the survey indices in the absence of catch information.

Explore alternative biomass indices for development of biomass proxies for reference point determination based on multiple survey indices.

Explore alternative decision support methodologies for updating TALs directly from relative trends in abundance without relying on direct estimates of F.

Spanish Mackerel

Weight and especially length at age of Spanish mackerel needs to be evaluated.

Methodology for predicting year class strength should be developed, and the relationship between larval abundance and subsequent year class strength should be examined and defined.

Yield per recruit analyses need to be conducted relative to alternative selective fishing patterns.

Evaluate the potential bias of the lack of appropriate stratification of the data used to generate age-length keys for Atlantic and Gulf Spanish mackerel.

Evaluation of CPUE indices related to standardization methods and management history, with emphasis on greater temporal and spatial resolution in estimates of CPUE

Research needs to be completed on the application of assessment and management models relative to dynamic species such as Spanish mackerel.

Spiny Dogfish

Additional analyses of sea sampling data since 1994.

Continue work on the change-in-ratio estimators for mortality rates and suggest several options for analyses.

Analyze the effects of environmental conditions on survey catch rates.

Further analyses of the commercial fishery is also warranted, especially with respect to the effects of gear types, mesh sizes, and market acceptability on the mean size of landed dogfish.

Spot

In trawl fisheries or other fisheries that take significant numbers of spot, states should monitor and report on the extent of unutilized bycatch and fishing mortality on fish less than age-1. Incorporate bycatch estimates into spot assessment models

Fishery dependent and independent size and sex specific relative abundance estimates should be developed.

A yield per recruit analysis should be cooperatively developed.

Summer Flounder

Investigate the source of bias in estimating terminal parameters of the VPA (fishing mortality and stock size). Partially addressed in SARC 25 assessment.

Develop a standardized index of abundance from NEFSC sea sampling data to provide a commercial fishery index that accounts for all removals by the fishery.

Develop information on optimum length/age at capture and optimum mesh size.

Collect and analyze age/length samples and catch/effort data from the commercial and recreational fisheries throughout the range of summer flounder.

Weakfish

Collect catch and effort data including size and age composition of the catch, determine stock mortality throughout the range, and define gear characteristics. In particular, increase length-frequency sampling, particularly in fisheries from Maryland and further north.

Develop latitudinal / seasonal / gear specific age length keys for the Atlantic coast. Increase sample sizes to consider gear specific keys.

Additional investigation is needed in developing consistent otolith-based catch matrices including the EM algorithm.

The impact of aging errors and other statistical uncertainties in the catch-at-age matrix on virtual population analysis (VPA) should be included. Retrospective analyses are needed on all VPA approaches investigated.

Develop a spawner recruit relationship and examine the relationships between parental stock size and environmental factors on year-class strength.

Develop a spawner recruit relationship and examine the relationships between parental stock size and environmental factors on year-class strength.

Winter Flounder

Evaluate the utility of MA DMF sea sample data for *Southern New England-Mid-Atlantic* stock winter flounder.

Revise the recreational fishery discard estimates for the *Southern New England-Mid-Atlantic* stock by applying a consistent method across all years, if feasible (i.e., the Gibson 1996 method).

Evaluate effects of smoothed length-frequency distributions on the relationship between survey and commercial catches at length for the *Gulf of Maine* stock.

STOCK ASSESSMENT RELATED ISSUES

General Assessment Studies

American Eel

A stock assessment committee should identify the best stock assessment methods for American eel.

Regular periodic stock assessments and determination of fishing mortality rates (F) are required to develop a sustainable harvest rate in addition to determining whether the population is stable, decreasing, or increasing.

American Lobster

Combined analyses of inshore and offshore southern stocks produced intermediate results, and were sensitive to the research vessel series (Rhode Island inshore or NEFSC offshore) used for DeLury modeling. Quantitative methods for combining stock status and reference points to multiple stock areas are necessary for providing region-wide assessment advice for the American lobster resource through its range.

American Shad/River Herring

Determine and update biological benchmarks used in assessment modeling (fecundity at age, mean weight at age for both sexes, partial recruitment vector/maturity schedules) for American shad and river herring stocks in a variety of coastal river systems, including both semelparous and iteroparous stocks.

Conduct population assessments on river herrings - particularly needed in the south.

Atlantic Sea Herring

Develop a long-term strategy for assessing individual spawning stocks as a basis for more effective management of any heavily exploited portion(s) of the stock complex. Evaluate the merit of acoustic surveys and other techniques to achieve sub-stock complex monitoring.

Consider potential discards if fishing mortality increases in the future.

Atlantic Striped Bass

Develop refined and cost-efficient coastal monitoring regime for striped bass stocks, including spawning stock biomass modeling and virtual population analysis (VPA).

Improve methods for determining population sex ratio for use in estimates of spawning stock biomass and biological reference points.

Black Sea Bass

Explore alternative assessment models, including non-age based alternatives.

Bluefish

Explore alternative methods for assessing bluefish, such as length-based and modified DeLury models.

Any archived age data for bluefish should be aged and used to supplement North Carolina DMF keys in future assessments.

Horseshoe Crab

Conduct additional stock assessments and determine harvest mortality rates (F). Use these data to develop a more reliable sustainable harvest rate.

Red Drum

Investigate and evaluate new stock assessment techniques as alternatives to age-structured models. Conduct yield modeling on red drum.

Scup

Given the low number of age groups represented in the present catch-at-age matrix for scup, as well as the uncertainty associated with the age compositions of catches, primarily the discarded portion, consideration should be given to the future use of non-age-based assessment methods (*e.g.* DeLury).

Explore other assessment approaches, including Bayesian and bootstrap techniques that incorporate uncertainty in catch estimates. Explore models that incorporate within-year survey data.

Spotted Seatrout

Stock assessments should be conducted to determine the status of stocks relative to the plan objective of maintaining a spawning potential of at least 20%.

Age structure analyses by sex should be utilized in stock assessments.

Winter Flounder

Develop a geographically more comprehensive data set to calculate maturity at age, reflecting any differential availability of mature fish to inshore and offshore surveys for the *Southern New England-Mid-Atlantic* stock. Re-examine the maturity ogive to incorporate any recent research

results.

Process archived age samples from surveys and commercial landings, and develop analytical age based assessment for the *Gulf of Maine* stock.

MODELS AND MODELING STUDIES

MODELING STUDIES

DeLury Model

American Lobster

The inclusion of multiple survey indices in DeLury population models could potentially be useful in refining estimates of stock size and F, and should be explored.. (A preliminary version of the DeLury model with multiple indices has been developed, but was not available for SAW-22).

More precise and accurate DeLury model estimates of stock size and fishing mortality rates can be made if the relative selectivity of pre-recruit and fully recruited sizes to the bottom trawl survey gear is resolved. Appropriate field studies of lobster availability and R/V gear selectivity are considered a priori.

Investigate the effects of spatial distribution/movements/selectivity in the Delury model.

Include multiple input series in modeling for lobster.

Evaluate potential biases in the Delury analysis due to incomplete coverage in different substrates.

Undertake sensitivity analyses in the DeLury model.

Develop models with enhanced size/stage structure.

MODELING STUDIES

Egg and Yield Per Recruit Models

American Lobster

Yield-per-recruit analyses should be conducted for males.

Include process error in growth, reproduction, etc; and evaluate effects of assumptions of maximum intermolt periods, maximum size and the partitioning of natural mortality in the egg production per recruit model. Obtain information on molting frequency and lobster growth, mortality, and recruitment among years and geographical areas. (Estrella/Massachusetts has an ongoing hatchery study on this topic.)

Examine effects of measurement errors and define acceptable levels of risk in the egg production per recruit model.

Predictions of EPR models should be validated with respect to data from fishery-dependent and fishery-independent sources including: length frequency distribution of catch, projected growth trajectory, and size-specific sex ratios, fraction egg bearing, fraction soft shell, and fraction V-notched.

Explore alternatives to timing of events in the EPR model. Investigate geographic and seasonal patterns of growth, reproductive events, and fishing intensity from catch and sea sampling data. Standardize methods of sampling and statistical analysis are needed to determine these patterns.

Examine the sensitivity of F (10%) to input parameters in the egg production per recruit model. Specific information for micro-area is needed.

Include multiple input series in modeling for lobster.

Examine spatial differences in F (10%) in the egg production per recruit model.

Spot

A yield per recruit analysis should be cooperatively developed.

MODELING STUDIES

Surplus Production Models

Northern Shrimp

Expand the time series of stock and recruitment data using catchability estimates from the production model.

MODELING STUDIES

Recruitment Studies

MODELING STUDIES

Virtual Population Analysis

Atlantic Striped Bass

Review relationship between tag based survival estimates and VPA estimate of mortality in a management framework.

Summer Flounder

Investigate the source of bias in estimating terminal parameters of the VPA (fishing mortality and stock size). Partially addressed in SARC 25 assessment.

Weakfish

The impact of aging errors and other statistical uncertainties in the catch-at-age matrix on virtual population analysis (VPA) should be included. Retrospective analyses are needed on all VPA approaches investigated.

Winter Flounder

Evaluate the feasibility of virtual population analysis based only on ages fully recruited to landings (i.e. no discards) for the *Gulf of Maine* stock.

DATA AND DATABASE RELATED ISSUES

DATA AND DATABASE ISSUES

General Landings and Data Issues

American Eel

Documentation of the commercial eel fishery should be more accurate so that our understanding of participation in the fishery and the amount of directed effort could be known.

American Lobster

Quantify changes in the spatial distribution of effort.

Develop area-specific data on effort and LPUE. (Forthcoming with ACCSP logbook)

Develop standardized LPUE-index fishers.

Examine trap effects on catch.

Develop a time series of standardized fishing effort and compare with F.

American Shad/River Herring

Develop comprehensive angler use and harvest survey techniques for use by Atlantic states to assess recreational fisheries for American shad.

Atlantic Croaker

Fishery dependent and independent size, age and sex specific relative abundance estimates should be developed to monitor long term changes in croaker abundance.

Improve catch and effort statistics from the commercial and recreational fisheries, along with size and age structure of the catch.

Atlantic Menhaden

Monitor landings, size, age, gear, and harvest area in the reduction and bait fisheries, and determine age composition by area. Enhance biostatistical sampling of bait samples in purse seine fisheries for Virginia and New Jersey to improve stock assessment.

Alternative measures of effort, including spotter pilot logbooks, trip length, or other variables, should be evaluated. Spotter pilot logbooks should be evaluated for spotter plane search time, GPS coordinates, and estimates of school sizes observed by pilots.

Black Sea Bass

Sampling should be increased for commercial landing in black sea bass fisheries, specifically the fish pot fisheries in the Mid-Atlantic. Age sampling should be increased across all components of

the commercial fishery.

Sampling should be increased in the recreational fisheries. Age data should be collected from the total catch, and length sampling should be done to characterize size structure of discards.

Bluefish

Sampling of size and age composition of the fisheries by gear type and statistical area should be increased.

Commercial and recreational landings of bluefish should be targeted for biological data collection wherever possible.

Initiate fisheries dependent and independent sampling of offshore populations of bluefish during winter months.

Northern Shrimp

Characterize demographics of the fishing fleet by area and season; perform comparative analysis of fishing practices between areas.

Red Drum

Improve catch/effort estimates and biological sampling from recreational and commercial fisheries for red drum, including increased efforts to intercept night-time fisheries for red drum by the NMFS MRFSS. Characterize magnitude of commercial and recreational discards.

Spanish Mackerel

Length, sex, age, and CPUE data are needed to improve the stock assessment accuracy. Simulations on CPUE trends should be explored and impacts on VPA and assessment results determined. Data collection is needed for all states, particularly those north of North Carolina.

Weight and especially length at age of Spanish mackerel needs to be evaluated.

More timely reporting of mid-Atlantic catches is needed for quota monitoring.

Provide better estimates of recruitment, natural mortality rates, fishing mortality rates, and standing stock. Specific information should include an estimate of total amount caught and distribution of catch by area, season, and type of gear.

Spiny Dogfish

Further analyses of the commercial fishery is also warranted, especially with respect to the effects of gear types, mesh sizes, and market acceptability on the mean size of landed dogfish.

Recover and encode information on the sex composition prior to 1980 from the survey database.

Monitor the level of effort and harvest in other fisheries as a result of no directed fishery for spiny dogfish.

Quantify effort directed on spiny dogfish in waters outside of the U.S.

Spot

Improve spot catch and effort statistics from the commercial and recreational fisheries, along with size and age structure of the catch, in order to develop production models.

Spotted Seatrout

MRFSS should be expanded to assure adequate data collection for catch and effort data and for increased intercepts and state add-ons of social and economic data needs.

Collection of commercial and recreational landings data should be continued and expanded.

Improve precision of effort reporting through commercial trip ticket programs.

Summer Flounder

Collect and analyze age/length samples and catch/effort data from the commercial and recreational fisheries throughout the range of summer flounder.

Tautog

Collect effort data for determining commercial and recreational CPUE.

Weakfish

Collect catch and effort data including size and age composition of the catch, determine stock mortality throughout the range, and define gear characteristics. In particular, increase length-frequency sampling, particularly in fisheries from Maryland and further north.

Winter Flounder

Maintain or increase sampling levels and collect age information from MRFSS samples for the

Southern New England-Mid-Atlantic stock.

Maintain or increase sampling levels and collect age information from MRFSS samples for the *Gulf of Maine*.

BYCATCH AND DISCARD ESTIMATES

BYCATCH AND DISCARD ESTIMATES

Domestic Sea Sampling Program

Atlantic Croaker

In trawl fisheries or other fisheries that historically take significant numbers of croaker, states should monitor and report on the extent of unutilized bycatch and fishing mortality on fish less than age-1. Incorporate bycatch estimates into croaker assessment models.

Atlantic Menhaden

Develop bycatch studies of menhaden by other fisheries.

Atlantic Sea Herring

Consider potential discards if fishing mortality increases in the future.

Atlantic Striped Bass

Develop studies to provide information on the magnitude of hook and release and bycatch mortality, including factors that influence their magnitude and means of reducing or eliminating this source of mortality.

Increase sea sampling of commercial fisheries, such as the dogfish gillnet fishery, which may have high levels of discards.

Atlantic Sturgeon

Characterize size, condition, and relative abundance of Atlantic sturgeon by gear and season taken as bycatch in various fisheries.

Evaluate existing sea sampling data to characterize at-sea migratory behavior.

Black Sea Bass

Increase sea sampling to verify information from commercial logbooks to provide better estimates of discards.

Northern Shrimp

Continue sea-sampling efforts. Power analysis of estimates of mean weight from port sampling should be investigated to optimize sample design.

Improve separator and excluder devices to reduce bycatch and discard of non-targeted species. Explore gear modifications, such as larger mesh, to minimize shrimp bycatch in finfish trawl fisheries.

Efforts to quantify the magnitude of bycatch by species, area, and season should be continued and the steps necessary to limit negative impacts taken.

Scup

Increased and more representative sea sampling of the various fisheries in which scup are caught (both as a targeted and non-targeted species) is needed to adequately characterize the length composition of discards. A pilot study to develop a sampling program to estimate discards should be implemented.

A study to develop optimum sampling levels to estimate discards should be implemented. This would quantify the advantages to obtaining sea samples from freezer trawlers and other small mesh fleets from which few samples have been collected, and would provide an opportunity for joint industry research programs.

A study to develop optimum sampling levels to estimate discards should be implemented. This would quantify the advantages to obtaining sea samples from freezer trawlers and other small mesh fleets from which few samples have been collected, and would provide an opportunity for joint industry research programs.

Design an optimal sampling plan that would be considered for implementation by the fishery observer sampling, recreational and commercial port sampling program.

Quantify the percentage of commercial fishery trips that had discards but no landings, and evaluate how such trips contribute to the total commercial fishery discard estimate.

Spiny Dogfish

Characterize and quantify bycatch of spiny dogfish in other fisheries.

Increase observer trips to document the level of incidental capture of spiny dogfish during the spawning stock rebuilding period.

Additional analyses of sea sampling data since 1994.

Spot

In trawl fisheries or other fisheries that take significant numbers of spot, states should monitor and report on the extent of unutilized bycatch and fishing mortality on fish less than age-1. Incorporate bycatch estimates into spot assessment models

Summer Flounder

Monitor abundance of juvenile summer flounder on a yearly basis.

Winter Flounder

Expand sea sampling for estimation of *coastwide and Southern New England-Mid-Atlantic* commercial discards.

Expand sea sampling in order to validate commercial discard estimates from Vessel Trip Reports (logbooks) for the *Gulf of Maine* stock.

Evaluate the utility of MA DMF sea sample data for *Southern New England-Mid-Atlantic* stock winter flounder.

BYCATCH AND DISCARD ESTIMATES

Marine Recreational Fisheries Statistics Survey (MRFSS)

Atlantic Striped Bass

Develop studies to provide information on the magnitude of hook and release and bycatch mortality, including factors that influence their magnitude and means of reducing or eliminating this source of mortality.

Black Sea Bass

Sampling should be increased in the recreational fisheries. Age data should be collected from the total catch, and length sampling should be done to characterize size structure of discards.

Northern Shrimp

Efforts to quantify the magnitude of bycatch by species, area, and season should be continued and the steps necessary to limit negative impacts taken.

Red Drum

Improve catch/effort estimates and biological sampling from recreational and commercial fisheries for red drum, including increased efforts to intercept night-time fisheries for red drum by the NMFS MRFSS. Characterize magnitude of commercial and recreational discards.

Spiny Dogfish

Characterize and quantify bycatch of spiny dogfish in other fisheries.

Spot

In trawl fisheries or other fisheries that take significant numbers of spot, states should monitor and report on the extent of unutilized bycatch and fishing mortality on fish less than age-1. Incorporate bycatch estimates into spot assessment models.

Summer Flounder

Encourage research to determine the length and age frequency and discard mortality rates of commercial and recreational fishery summer flounder discards.

Undertake research to determine hooking mortality on summer flounder by circle, kahle, and regular "J" hooks and make the results of work already completed available to the Management Board.

Weakfish

Continue studies on recreational hook-and-release mortality rates, including factors such as depth, warmer water temperatures, and fish size in the analysis. Further consideration of release mortality

in both the recreational and commercial fisheries is needed, and methods investigated to improve survival among released fish.

Winter Flounder

Revise the recreational fishery discard estimates by applying a consistent method across all years, if feasible (i.e., the Gibson 1996 method) for the *Southern New England-Mid-Atlantic* stock.

Estimate/evaluate effects of catch-and-release components of recreational fishery on discard at age for the *Southern New England-Mid-Atlantic and Gulf of Maine* stocks (i.e. develop mortality estimates from the American Littoral Society tagging database, if feasible).

Estimate/evaluate effects of catch-and-release components of recreational fishery on discard at age.

BYCATCH AND DISCARD ESTIMATES

Commercial Fisheries

Northern Shrimp

Modify sea sampling protocol to characterize discards of shrimp in the shrimp trawl fishery and the small-mesh whiting fishery.

Efforts to quantify the magnitude of bycatch by species, area, and season should be continued and the steps necessary to limit negative impacts taken.

Red Drum

Improve catch/effort estimates and biological sampling from recreational and commercial fisheries for red drum, including increased efforts to intercept night-time fisheries for red drum by the NMFS MRFSS. Characterize magnitude of commercial and recreational discards.

Spanish Mackerel

Determine the bycatch of Spanish mackerel in the directed shrimp fishery in Atlantic coastal waters.

Spiny Dogfish

Determine coastwide discard mortality rate for fixed and mobile gear fisheries that catch dogfish as bycatch.

Characterize and quantify bycatch of spiny dogfish in other fisheries.

Spot

In trawl fisheries or other fisheries that take significant numbers of spot, states should monitor and report on the extent of unutilized bycatch and fishing mortality on fish less than age-1. Incorporate bycatch estimates into spot assessment models.

Summer Flounder

Encourage research to determine the length and age frequency and discard mortality rates of commercial and recreational fishery summer flounder discards.

Develop a consistent and accurate sampling program to determine the mesh selectivity for summer flounder and other commercial fisheries taken in mixed fisheries, and to determine discard mortality.

Develop fish excluder devices to reduce bycatch of immature flatfish in fisheries that target species other than flounder.

Weakfish

Derive estimates of discard mortality rates and the magnitude of discards for all commercial gear types from both directed and non-directed fisheries. In particular, quantify trawl bycatch, refine estimates of mortality for below minimum size fish, and focus on factors such as distance from shore and geographical differences. Update the scale – otolith comparison for weakfish.

Winter Flounder

Explore the feasibility of stratification of commercial fishery discard estimation by fishery in the *Southern New England-Mid-Atlantic* stock (e.g., mesh, gear, area).

Expand sea sampling for estimation of commercial discards for *coastwide and Southern New England-Mid-Atlantic* stocks.

BIOLOGICAL SAMPLING ISSUES

BIOLOGICAL SAMPLING ISSUES

Domestic Sea Sampling Program

American Lobster

Enhanced sea sampling and/or port sampling of offshore catches is urgently needed for biological characteristics of catches and landings since current sampling in these areas is considered inadequate for assessment purposes. (See Note Reference Section concerning work being conducted by the NEFSC)

Methods should be developed to derive standardized catch-per-unit-effort indices which include trap attributes, season, soak time, etc. Sea sampling should be modified to include collection of potentially important variables.

Bluefish

Increase sampling frequencies when bluefish are encountered, especially when medium size fish are encountered.

Scup

Design an optimal sampling plan that would be considered for implementation by the fishery observer sampling, recreational and commercial port sampling program.

Spotted Seatrout

Emphasis should be placed on collecting the necessary biological data to be able to conduct stock assessments and to assist in drafting fishery management plans.

Weakfish

Develop latitudinal / seasonal / gear specific age length keys for the Atlantic coast. Increase sample sizes to consider gear specific keys.

BIOLOGICAL SAMPLING ISSUES

Marine Recreational Fisheries Statistics Survey (MRFSS)

Black Sea Bass

Sampling should be increased in the recreational fisheries. Age data should be collected from the total catch, and length sampling should be done to characterize size structure of discards.

Bluefish

Commercial and recreational landings of bluefish should be targeted for biological data collection wherever possible.

Increase intensity of biological sampling of the NER commercial and coastwide recreational fisheries.

Increase sampling frequencies when bluefish are encountered, especially when medium size fish are encountered.

Red Drum

Improve catch/effort estimates and biological sampling from recreational and commercial fisheries for red drum, including increased efforts to intercept night-time fisheries for red drum by the NMFS MRFSS. Characterize magnitude of commercial and recreational discards.

Scup

Expand age sampling of scup from commercial and recreational catches, with special emphasis on collection of large specimens.

Design an optimal sampling plan that would be considered for implementation by the fishery observer sampling, recreational and commercial port sampling program.

Spotted Seatrout

Emphasis should be placed on collecting the necessary biological data to be able to conduct stock assessments and to assist in drafting fishery management plans.

Summer Flounder

Encourage research to determine the length and age frequency and discard mortality rates of commercial and recreational fishery summer flounder discards.

Tautog

Sample hard parts for annual aging from the catches of recreational and commercial fisheries and fishery-independent surveys throughout the range of the stock.

Increase length sampling from the recreational fishery for all states from Massachusetts through Virginia.

Weakfish

Collect catch and effort data including size and age composition of the catch, determine stock mortality throughout the range, and define gear characteristics. In particular, increase length-frequency sampling, particularly in fisheries from Maryland and further north.

Develop latitudinal / seasonal / gear specific age length keys for the Atlantic coast. Increase sample sizes to consider gear specific keys.

Winter Flounder

Maintain or increase sampling levels and collect age information from MRFSS samples for the *Southern New England-Mid-Atlantic* stock.

Maintain or increase sampling levels and collect age information from MRFSS samples for the *Gulf of Maine*.

BIOLOGICAL SAMPLING ISSUES

Commercial Port Sampling

American Lobster

Enhanced sea sampling and/or port sampling of offshore catches is urgently needed for biological characteristics of catches and landings since current sampling in these areas is considered inadequate for assessment purposes. (See Note Reference Section concerning work being conducted by the NEFSC).

Atlantic Menhaden

Monitor landings, size, age, gear, and harvest area in the reduction and bait fisheries, and determine age composition by area. Enhance biostatistical sampling of bait samples in purse seine fisheries for Virginia and New Jersey to improve stock assessment.

Atlantic Sturgeon

Standardize collection procedures and develop suitable long-term repository for biological tissues for use in genetic and other studies.

Black Sea Bass

Sampling should be increased for commercial landing in black sea bass fisheries, specifically the fish pot fisheries in the Mid-Atlantic. Age sampling should be increased across all components of the commercial fishery.

Bluefish

Commercial and recreational landings of bluefish should be targeted for biological data collection wherever possible.

Increase intensity of biological sampling of the NER commercial and coastwide recreational fisheries.

Increase sampling frequencies when bluefish are encountered, especially when medium size fish are encountered.

Red Drum

Improve catch/effort estimates and biological sampling from recreational and commercial fisheries for red drum, including increased efforts to intercept night-time fisheries for red drum by the NMFS MRFSS. Characterize magnitude of commercial and recreational discards.

Scup

Expand age sampling of scup from commercial and recreational catches, with special emphasis on collection of large specimens.

Design an optimal sampling plan that would be considered for implementation by the fishery observer sampling, recreational and commercial port sampling program.

Spiny Dogfish

Increase the biological sampling of dogfish on research trawl surveys and in the commercial fishery.

Spotted Seatrout

Emphasis should be placed on collecting the necessary biological data to be able to conduct stock assessments and to assist in drafting fishery management plans.

Summer Flounder

Encourage research to determine the length and age frequency and discard mortality rates of commercial and recreational fishery summer flounder discards.

Tautog

Initiate biological sampling of the commercial catch for each gear type over the entire range of the stock (Including weight, lengths, age, sex, and discards).

Sample hard parts for annual aging from the catches of recreational and commercial fisheries and fishery-independent surveys throughout the range of the stock.

Weakfish

Collect catch and effort data including size and age composition of the catch, determine stock mortality throughout the range, and define gear characteristics. In particular, increase length-frequency sampling, particularly in fisheries from Maryland and further north.

Develop latitudinal / seasonal / gear specific age length keys for the Atlantic coast. Increase sample sizes to consider gear specific keys.

Winter Flounder

Improve sampling for biological data (particularly hard parts for ageing) of commercial landings of *Gulf of Maine* winter flounder.

STOCK IDENTIFICATION ISSUES

American Lobster

Resolve the question of stock identification, particularly as related to inshore/offshore components south of Georges Bank. Appropriate genetic studies are highly recommended and a compilation and analysis of existing tagging data should be undertaken prior to any new tagging studies. (Bruce Estrella complied tagging studies in the early 1990s. The Technical Committee concluded that this compilation was fruitless because many databases were lost and the lack of consistent information across studies made it difficult for comparisons. See Note in References Section concerning work being conducted by the NEFSC).

Assess the utility of satellite DNA and apply throughout range, if promising. Genetic identity of LIS population should be examined. (Dr. Irv Kornfield, University of Maine, paper in press/process for LIS data; papers on utility of satellite DNA should be out. See Note in Reference Section.)

Atlantic Croaker

Conduct stock identification research on croaker.

Atlantic Striped Bass

Continue in-depth analysis of migrations, stock composition, etc. using mark-recapture data.

Atlantic Sturgeon

Determine the extent to which Atlantic sturgeon are genetically differentiable among rivers.

Spanish Mackerel

Identification of Spanish mackerel stocks through multiple research techniques needs to be completed.

Spiny Dogfish

Genetic analysis of spiny dogfish to determine if more than one unit stock exist along the Northwest Atlantic.

Spot

Develop stock identification methods.

Spotted Seatrout

Work should be continued to examine the stock structure of spotted seatrout on a regional basis, with particular emphasis on molecular techniques.

Summer Flounder

Develop stock identification methods via meristics, morphometrics, biochemical research and tagging; particularly off Virginia and North Carolina.

Tautog

Explore possible regional and local genetic differences (stock differentiation) and relate these to recruitment, growth, exploitation rates, and habitat differences. These differences can help support appropriate region-specific management strategies.

Weakfish

Identify stocks and determine coastal movements and the extent of stock mixing, including characterization of stocks in overwintering grounds. (e.g. tagging).

Winter Flounder

Conduct studies to delineate all major substocks in terms of geographic spawning area and seasonal offshore movements (e.g. exposure to fishing pressure) for the *Southern New England-Mid-Atlantic* stock.

Examine the implications of stock mixing from data from the Great South Channel region (*Southern New England-Mid-Atlantic* stock).

Further examine the stock boundaries to determine if Bay of Fundy winter flounder should be included in the *Gulf of Maine* stock complex.

Resource Survey Issues

RESOURCE SURVEY ISSUES

Data Analyses

American Lobster

Analyze effects of different spatial combinations of survey stations in the Delury model.

Explore alternatives to timing of events in the EPR model. Investigate geographic and seasonal patterns of growth, reproductive events, and fishing intensity from catch and sea sampling data. Standardize methods of sampling and statistical analysis are needed to determine these patterns.

Atlantic Sea Herring

Potential changes in catchability within spring bottom trawl survey indices should be investigated.

Scup

A comprehensive database should be maintained that includes all available data from the scup commercial and recreational fishery, research surveys, and sea and port sampling programs, with timely updates from participating agencies.

Data and Database Issues

RESOURCE SURVEY ISSUES

Gear Design and Research

American Lobster

Explore alternatives to timing of events in the EPR model. Investigate geographic and seasonal patterns of growth, reproductive events, and fishing intensity from catch and sea sampling data. Standardize methods of sampling and statistical analysis are needed to determine these patterns.

Conduct cooperative studies with fishers on gear efficiency.

Investigate the effects of spatial distribution/movements/selectivity in the Delury model.

Atlantic Croaker

The effects of mandated bycatch reduction devices (BRD's) on croaker catch should be evaluated and compiled.

Northern Shrimp

Improve separator and excluder devices to reduce bycatch and discard of non-targeted species. Explore gear modifications, such as larger mesh, to minimize shrimp bycatch in finfish trawl fisheries.

Evaluate vulnerability of shrimp to various fishing gear.

Spot

The effects of mandated bycatch reduction devices (BRD's) on spot catch should be evaluated in those states with significant commercial harvests.

Summer Flounder

Research directed at evaluating the mesh exemption program should be continued, with increased sample sizes to allow reliable statistical testing of results.

Develop fish excluder devices to reduce bycatch of immature flatfish in fisheries that target species other than flounder.

Develop fish excluder devices to reduce bycatch of immature flatfish in fisheries that target species other than flounder.

Tautog

Determine pot and trap escape vent dimensions needed to release tautog over a range of sizes.

Weakfish

Collect catch and effort data including size and age composition of the catch, determine stock mortality throughout the range, and define gear characteristics. In particular, increase length-frequency sampling, particularly in fisheries from Maryland and further north.

Continue studies on mesh-size selectivity; up-to-date (1995) information is available only for North Carolina's gill net fishery. Mesh-size selectivity studies for trawl fisheries are particularly sparse.

Winter Flounder

Conduct gear study to determine selectivity of diamond and square mesh sizes 6 inches on *coastwide* winter flounder (and other groundfish species).

Evaluate size-selectivity performance of survey gear compared to typical commercial gear, and implications for estimation of commercial discards from research survey length frequency information for the *Gulf of Maine* stock.

RESOURCE SURVEY ISSUES

Survey Program Modifications

American Eel

A coast wide sampling program for American eel should be formulated using standardized and statistically robust methodologies. A critical review of the existing sampling plan should be conducted.

American Lobster

Develop a monitoring plan to detect recruitment decline.

Explore alternatives to timing of events in the EPR model. Investigate geographic and seasonal patterns of growth, reproductive events, and fishing intensity from catch and sea sampling data. Standardize methods of sampling and statistical analysis are needed to determine these patterns.

Terminologies for lobster life stages need to be defined and standardized for each state's sampling programs in order to ensure comparability and synthesis of available data.

Terminologies for lobster life stages need to be defined and standardized for each state's sampling programs in order to ensure comparability and synthesis of available data.

American Shad/River Herring

Evaluate and ultimately validate large-scale hydroacoustic methods to quantify American shad escapement (spawning run numbers) in major river systems. Identify how shad respond (attract/repelled) by various hydroacoustic signals.

Atlantic Croaker

Fishery dependent and independent size, age and sex specific relative abundance estimates should be developed to monitor long term changes in croaker abundance.

Cooperative coastwide croaker juvenile indices should be developed and validated to clarify stock status.

Continue monitoring of juvenile croaker populations in major nursery areas.

Atlantic Menhaden

Develop and test methods for estimating size of recruiting year-classes of juveniles using fishery-independent survey techniques.

The feasibility of estimating yearclass strength using biologically stratified sampling design should be evaluated. The efforts could be supported by process studies linking plankton production to abundance of young menhaden (need resources).

Atlantic Sea Herring

Develop a long-term strategy for assessing individual spawning stocks as a basis for more effective management of any heavily exploited portion(s) of the stock complex. Evaluate the merit of acoustic surveys and other techniques to achieve sub-stock complex monitoring.

Pursue the development of a dedicated pelagic survey technique utilizing hydroacoustic and trawling methods to provide another direct and independent means of estimating stock sizes. Collaborative work between NMFS, DFO, state agencies, and the herring industry on acoustic surveys for herring should be encouraged.

Develop new approaches to estimating recruitment (i.e. juvenile abundance) from fishery-independent data.

Continue resource monitoring activities, especially larval surveys to evaluate distribution and abundance of herring larvae, and to indicate the relative importance of individual spawning areas and stocks and the degree of spawning stock recovery on Georges Bank and Nantucket Shoals.

Black Sea Bass

Develop fishery independent surveys and expand existing surveys to capture all sizes and age classes in order to develop independent catch-at-age and CPUE.

Consideration should be given to a pot survey for an index of abundance.

Bluefish

Initiate fisheries dependent and independent sampling of offshore populations of bluefish during winter months.

A coastal surf-zone seine study needs to be initiated to provide more complete indices of juvenile abundance.

Horseshoe Crab

Evaluate the effectiveness of currently used benthic sampling gear for stock assessment.

Develop a young-of-year or age 1 recruitment index from the Delaware 16-foot trawl survey.

Red Drum

Support fishery-independent sampling of sub-adult and adult red drum in each state from North Carolina to Florida. The purpose of this survey would be to: 1) verify escapement to the spawning population, 2) provide an index of recruitment to age 1, and 3) provide an estimate of the biomass of adult red drum.

Scup

Develop fishery independent surveys and expand existing surveys to capture all sizes and age classes in order to develop independent catch-at-age and CPUE.

Further biological studies are needed to look at factors affecting annual availability of scup to research surveys and maturity schedules.

Surveys should be evaluated to test the assumption of equal catchability at age in projections (*i.e.* through forward projection methods).

Spanish Mackerel

Develop fishery independent methods of monitoring stock size of Atlantic Spanish mackerel (consider aerial surveys used in south Florida waters).

Methodology for predicting year class strength should be developed, and the relationship between larval abundance and subsequent year class strength should be examined and defined.

Temporal and spatial sampling to delineate spawning areas and areas of larval abundance should be initiated.

Spiny Dogfish

Review surveys to decide if mid-water trawling surveys should be included with bottom surveys to increase biological sampling of dogfish.

Review surveys to decide if mid-water trawling surveys should be included with bottom surveys to increase biological sampling of dogfish.

Spot

Fishery dependent and independent size and sex specific relative abundance estimates should be developed.

Cooperative coastwide spot juvenile indices should be developed to clarify stock status.
Monitor long term changes in spot abundance, growth rates, and age structure.

Continue monitoring of juvenile spot populations in major nursery areas.

Spotted Seatrout

Initiate fishery independent surveys of spotted seatrout.

Summer Flounder

Monitor abundance of juvenile summer flounder on a yearly basis.

Monitor abundance of juvenile summer flounder on a yearly basis.

Develop fishery independent surveys and expand existing surveys to capture all sizes and age classes in order to develop independent catch-at-age and CPUE.

Develop a consistent and accurate sampling program to determine the mesh selectivity for summer flounder and other commercial fisheries taken in mixed fisheries, and to determine discard mortality.

Develop a standardized index of abundance from NEFSC sea sampling data to provide a commercial fishery index that accounts for all removals by the fishery.

Investigate the utility of alternative strata sets for the NEFSC spring trawl survey time series for summer flounder.

Encourage research to determine the length and age frequency and discard mortality rates of commercial and recreational fishery summer flounder discards.

Tautog

Establish standardized state-by-state long-term fisheries independent surveys to monitor tautog abundance and length-frequency distributions, and to develop young-of-the-year indices.

Sample hard parts for annual aging from the catches of recreational and commercial fisheries and fishery-independent surveys throughout the range of the stock.

Weakfish

Conduct hydrophonic studies to delineate weakfish spawning habitat locations and environmental preferences (temperature, depth, substrate, etc.) and enable quantification of spawning habitat.

Winter Flounder

Compile NEFSC Winter Survey abundance indices for winter flounder and evaluate their activity

in the *Southern New England-Mid-Atlantic* stock.

LIFE HISTORY STUDIES

LIFE HISTORY STUDIES

Age Determinations

American Eel

Workshop on aging and sexing techniques should be considered to increase the accuracy of data collected in coastwide sampling program.

American Shad/River Herring

Continue to assess current aging techniques for American shad and river herring, using known age fish, scales, otoliths, and spawning marks. Conduct bi-annual aging workshops to maintain consistency and accuracy of aging of fish sampled in state programs.

Validate the different values of M for shad stocks through verification of shad aging techniques and repeat spawning information and develop methods for calculating M.

Atlantic Croaker

Criteria should be cooperatively developed for aging croaker otoliths.

Atlantic Striped Bass

Further study should be conducted on the discrepancy in ages between scale-based and otolith-based ages. Particular emphasis should be placed on comparisons with known age fish determined from coded wire tags. Comparisons should be made among age readers and areas.

Atlantic Sturgeon

Evaluate aging techniques for Atlantic sturgeon with known age fish. Emphasis should be placed on verifying current methodology based on fin rays. Determine length, fecundity, and maturity at age for North, Mid and South Atlantic stocks.

Bluefish

A scale-otolith age comparison study needs to be completed for bluefish.

Any archived age data for bluefish should be aged and used to supplement North Carolina DMF keys in future assessments.

Northern Shrimp

Methods for age determination from length and ontogenetic stage information should be continued to develop the possibility of using age-based assessment methods.

Spiny Dogfish

Standardize age determination along the entire East coast.

Spot

Criteria should be cooperatively developed for aging spot otoliths and scales, and an age validation study should be conducted.

Weakfish

Derive estimates of discard mortality rates and the magnitude of discards for all commercial gear types from both directed and non-directed fisheries. In particular, quantify trawl bycatch, refine estimates of mortality for below minimum size fish, and focus on factors such as distance from shore and geographical differences. Update the scale – otolith comparison for weakfish.

Winter Flounder

Further examine the comparability of age length keys from different areas within the stock (current comparisons are based on two years and three ages) for the *Southern New England-Mid-Atlantic* stock. Conduct an age structure comparison between NEFSC, CT DEP and MADMF, to ensure consistency in ageing protocol (work in progress).

Age archived MA DMF survey age samples for 1978-1989 (*Southern New England-Mid-Atlantic* stock).

Process archived age samples from surveys and commercial landings, and develop analytical age based assessment for the *Gulf of Maine* stock.

LIFE HISTORY STUDIES

Species Distribution Studies

American Eel

Investigate: fecundity, length and weight relationships for females throughout their range; growth rates for males and females throughout their range; predator-prey relationships; behavior and movement of eel during their freshwater residency; oceanic-behavior, movement and spawning location of adult mature eel; and all information on the leptocephalus stage of eel.

Examination of the mechanisms for exit from Sargasso Sea and transport across the continental shelf.

American Lobster

Migratory routes and guidance mechanisms for silver eel in the ocean should be examined.

Investigate the effects of spatial distribution/movements/selectivity in the Delury model.

Compile existing larval data - transfer rates.

Investigate spatial differences in demography of American lobster.

American Shad/River Herring

Determine which stocks are impacted by coastal intercept fisheries (including bycatch fisheries). Methods to be considered to differentiate among stocks could include otolith micro-chemistry, oxy-tetracycline otolith marking and/or tagging.

Conduct studies on energetics of feeding and spawning migrations of shad on the Atlantic coast.

Atlantic Croaker

Determine the onshore vs. offshore components of the croaker fishery.

Determine migratory patterns and mixing rates through cooperative, multi-jurisdictional tagging studies.

Atlantic Striped Bass

Continue in-depth analysis of migrations, stock composition, etc. using mark-recapture data.

Black Sea Bass

Identify transport mechanisms or behavior that move early juvenile black sea bass into estuaries.

Bluefish

Investigate the distribution of adult bluefish (particularly the spring-spawned cohort) in the South Atlantic Bight and juvenile bluefish (including the pelagic stage); and develop precise information on the distribution and relative abundance of bluefish in inshore areas, especially estuaries and embayments.

Northern Shrimp

Evaluate distribution of larval, juvenile, and adult shrimp. Evaluate migration and local movements.

Red Drum

Continue tagging studies to determine stock identity, inshore/offshore migration patterns and mortality estimation.

Document and characterize schooling behavior for Atlantic coast red drum.

Spanish Mackerel

Conduct migration studies to determine normal Spanish mackerel migration routes and changes therein, and the climatic or other factors responsible for changes in the environmental and habitat conditions which may affect the habitat and availability of stocks.

Determine the relationship, if any, between migration of prey species (engraulids, clupeids, carangids), and migration patterns of the Spanish mackerel stock.

Spot

Determine the onshore vs. offshore components of the spot fishery.

Determine migratory patterns through tagging studies.

Tautog

Define the specific spawning and pre-spawning aggregating areas and wintering areas of juveniles and adults used by all major local populations, as well as the migration routes used by tautog to get to and from spawning and wintering areas and the criteria or times of use. This information is required to protect these areas from damage and overuse or excessive exploitation.

Define local and regional movement patterns and site fidelity in the southern part of the species range. This information may provide insights into questions of aggregation vs. recruitment to artificial reef locations.

Define the source of offshore eggs and larvae (in situ or washed out coastal spawning).

Confirm that tautog, like cunner, hibernate in the winter, and in what areas and temperature thresholds, for how long, and are there special habitat requirements during these times that should be protected or conserved from damage or disturbance. This information will aid in understanding behavior variability and harvest availability.

Weakfish

Compile existing data on larval and juvenile distribution from existing databases in order to obtain preliminary indications of spawning and nursery habitat location and extent.

Biological studies should be conducted to better understand migratory aspects and how this relates to observed trends in weight at age.

Determine the onshore versus offshore components of the weakfish fishery.

LIFE HISTORY STUDIES

Fecundity Analyses

Atlantic Croaker

Examine reproductive biology of croaker with emphasis on developing maturity schedules and estimates of fecundity.

Bluefish

Conduct research to determine the timing of sexual maturity and fecundity of bluefish.

Northern Shrimp

Evaluate maturation, fecundity and lifetime spawning potential.

Estimates of fecundity at length should be updated, and the potential for annual variability should be explored.

Spiny Dogfish

Update maturation and fecundity estimates by length class.

Weakfish

Define reproductive biology of weakfish, including size at sexual maturity, maturity schedules, fecundity, and spawning periodicity. Continue research on female spawning patterns: what is the seasonal and geographical extent of "batch" spawning; do females exhibit spawning site fidelity?

LIFE HISTORY STUDIES

Food Habits and Trophic Ecology

American Eel

Investigate: fecundity, length and weight relationships for females throughout their range; growth rates for males and females throughout their range; predator-prey relationships; behavior and movement of eel during their freshwater residency; oceanic-behavior, movement and spawning location of adult mature eel; and all information on the leptocephalus stage of eel.

Assess characteristics and distribution of eel habitat and value of habitat with respect to growth and sex determination.

Investigate, develop, and improve technologies for American eel passage upstream and downstream of various barriers for each life stage. Emphasis should be placed on evaluation of low-cost alternatives for passage.

Examine the mode of nutrition for leptocephalus in the ocean.

Provide analysis of food habits of glass eel while at sea.

American Lobster

Examine effects of predation, regime shifts, etc.

American Shad/River Herring

Conduct studies on energetics of feeding and spawning migrations of shad on the Atlantic coast.

Atlantic Croaker

Determine species interactions and predator/prey relationships for croaker (prey) and other more highly valued fisheries (predators).

Atlantic Menhaden

Study the ecological role of menhaden (predator/prey relationships, nutrient enrichment, oxygen depletion, etc.) in major Atlantic coast embayments and estuaries.

Black Sea Bass

Evaluate food habits of black sea bass larvae and overwintering adults.

Bluefish

Continue research on species interactions and predator/prey relationships.

Horseshoe Crab

Evaluate the importance of horseshoe crabs to other marine resources such as sea turtles.

Northern Shrimp

Evaluate natural mortality, including relative impacts of predation and disease and variation at age and over time.

Evaluate competition and predator-prey relationships between species.

Scup

Continue studies on the importance of factors controlling the production and distribution of food items that appear in the diet of young scup.

Conduct research on the trophic relationships of scup.

Tautog

Define the role of prey type and availability in local juvenile/adult population dynamics over the species range. This information can explain differences in local abundance, movements, growth, fecundity, etc. Conduct studies in areas where the availability of primary prey, such as blue mussels or crabs, is dependent on annual recruitment, the effect of prey recruitment variability as a factor in tautog movements (to find better prey fields), mortality (greater predation exposure when leaving shelter to forage open bottom), and relationship between reef prey availability/quality on tautog condition/fecundity.

LIFE HISTORY STUDIES

Growth Studies

American Eel

Investigate: fecundity, length and weight relationships for females throughout their range; growth rates for males and females throughout their range; predator-prey relationships; behavior and movement of eel during their freshwater residency; oceanic-behavior, movement and spawning location of adult mature eel; and all information on the leptocephalus stage of eel.

Investigate fecundity, length and weight relationships for females throughout their range, and growth rates for males and females throughout their range.

American Lobster

Include process error in growth, reproduction, etc; and evaluate effects of assumptions of maximum intermolt periods, maximum size and the partitioning of natural mortality in the egg production per recruit model. Obtain information on molting frequency and lobster growth, mortality, and recruitment among years and geographical areas. (Estrella/Massachusetts has an ongoing hatchery study on this topic.)

Obtain information on natural mortality rates. The effects of alternative partitionings of natural mortality (M) between hardshell and softshell should be investigated, and attempts should be made to estimate rates from field or laboratory data.

Atlantic Croaker

Studies of croaker growth rates and age structure need to be conducted throughout the species range.

Atlantic Menhaden

Evaluate effects of selected environmental factors on growth, survival and abundance of juvenile and adult menhaden, particularly in Chesapeake Bay and other coastal nursery areas.

Growth back-calculation studies should be pursued to investigate historical trends in growth rate. The NMFS has an extensive data base on scale growth increments which should be utilized for this purpose.

Black Sea Bass

Studies on sex-specific mortality rates and growth are needed.

Northern Shrimp

Evaluate larval growth and survival in response to environmental conditions.

Evaluate growth, including frequency of molting and variation in growth rates as a function of

environmental factors and population density.

Winter Flounder

Examine growth variations within the Gulf of Maine, using results from the Gulf of Maine Biological Sampling Survey (1993-94).

LIFE HISTORY STUDIES

Habitat Issues and Studies

American Eel

Evaluate the impact, both upstream and downstream, of barriers on eel with respect to population and distribution effects. Determine relative contribution of historic loss of habitat to potential eel population and reproductive capacity.

American Shad/River Herring

Characterize tributary habitat quality and quantity for Alosa reintroductions and fish passage development.

Identify and quantify potential American shad spawning and rearing habitat not presently utilized and conduct an analysis of the cost of recovery.

Determine the effects of passage impediments on all life history stages of shad and river herring, conduct turbine mortality studies and downstream passage studies.

Atlantic Croaker

Identify essential habitat requirements.

Determine the impacts of any dredging activity (i.e. for beach re-nourishment) on all life history stages of croaker.

Atlantic Menhaden

Determine how loss/degradation of critical estuarine and nearshore habitat affects growth, survival and abundance of juvenile and adult menhaden abundance.

Atlantic Sea Herring

Identify known herring spawning areas. Establish critical spawning habitat areas or special management zones to protect spawning aggregations of herring and/or demersal egg masses.

Atlantic Sturgeon

Obtain baseline data on habitat condition and quantity in important sturgeon rivers. Data should address both spawning and nursery habitat.

Black Sea Bass

Further delineation of essential fish habitat (EFH), particularly in nursery areas. Further investigation of possible gear impacts on EFH.

Evaluate habitat use by overwintering yearling, young-of-the-year, and adult black sea bass.

A study determining the value of artificial reefs for increased production of black sea bass would be valuable in estimating potential yield.

Horseshoe Crab

Determine beach fidelity by horseshoe crabs to determine habitat use.

Evaluate the impacts of beach nourishment projects on horseshoe crab populations.

Red Drum

Determine habitat preferences, environmental conditions, growth rates, and food habits of larval and juvenile red drum throughout the species range along the Atlantic coast. Assess the effects of environmental factors on stock density.

Identify spawning areas of red drum in each state from North Carolina to Florida so these areas may be protected from degradation and/or destruction. Determine the impacts of dredging and beach re-nourishment on red drum spawning and early life history stages.

Quantify relationships between red drum production and habitat.

Investigate the concept of estuarine reserves to increase the escapement rate of red drum along the Atlantic coast.

Identify the effects of water quality degradation on the survival of red drum eggs, post-larvae, larvae, and juveniles.

Determine methods for restoring red drum habitat and/or improving existing environmental conditions that adversely affect red drum production.

Scup

Further delineation of essential fish habitat (EFH) particularly in nursery areas. Further investigation for possible gear impacts on EFH.

Spotted Seatrout

Identify essential habitat requirements.

Summer Flounder

Further delineation of essential fish habitat (EFH) particularly in nursery areas. Further investigation of possible gear impacts on EFH.

Evaluate the relationship between recruitment of summer flounder to nursery areas and Ekman transport or prevailing directions of water flow.

Tautog

Define the status (condition and extent) of optimum or suitable juvenile habitats and trends in specific areas important to the species. It is critical to protect these habitats or to stimulate restoration or enhancement, if required.

Define local and regional movement patterns and site fidelity in the southern part of the species range. This information may provide insights into questions of aggregation vs. recruitment to artificial reef locations.

Confirm that tautog, like cunner, hibernate in the winter, and in what areas and temperature thresholds, for how long, and are there special habitat requirements during these times that should be protected or conserved from damage or disturbance. This information will aid in understanding behavior variability and harvest availability.

Weakfish

Conduct hydrophonic studies to delineate weakfish spawning habitat locations and environmental preferences (temperature, depth, substrate, etc.) and enable quantification of spawning habitat.

Compile existing data on larval and juvenile distribution from existing databases in order to obtain preliminary indications of spawning and nursery habitat location and extent.

Document the impact of power plants and other water intakes on larval, post larval and juvenile weakfish mortality in spawning and nursery areas, and calculate the resultant impact to adult sock size.

Define restrictions necessary for implementation of projects in spawning and overwintering areas and develop policies on limiting development projects seasonally or spatially.

Winter Flounder

Focus research on quantifying mortality associated with habitat loss and alteration, contamination by toxics and power plant entrainment and impingement on a *coastwide* basis.

Conduct studies of flounder populations in impacted areas to fully quantify physiological adaptation to habitat alteration, and interactive effects, on an individual and population level on a *coastwide*

basis.

LIFE HISTORY STUDIES

Maturation Studies and Ogives

Atlantic Striped Bass

Develop maturity ogive applicable to coastal migratory stock.

Atlantic Sturgeon

Develop methods to determine sex and maturity of captured sturgeon.

Evaluate aging techniques for Atlantic sturgeon with known age fish. Emphasis should be placed on verifying current methodology based on fin rays. Determine length, fecundity, and maturity at age for North, Mid and South Atlantic stocks.

Bluefish

Conduct research to determine the timing of sexual maturity and fecundity of bluefish.

Northern Shrimp

Evaluate maturation, fecundity and lifetime spawning potential.

Investigate changes in transition and maturation as a function of stock size and temperature.

Red Drum

Refine maturity schedules on a geographic basis, determine relationships between annual egg production over a range of sizes, ages and across latitude.

Spiny Dogfish

Update maturation and fecundity estimates by length class.

Summer Flounder

Continue research to determine if the maturity ogive accurately reflects spawning potential of summer flounder.

Weakfish

Define reproductive biology of weakfish, including size at sexual maturity, maturity schedules, fecundity, and spawning periodicity. Continue research on female spawning patterns: what is the seasonal and geographical extent of "batch" spawning; do females exhibit spawning site fidelity?

Winter Flounder

Develop a geographically more comprehensive data set to calculate maturity at age, reflecting any differential availability of mature fish to inshore and offshore surveys for the *Southern New England-Mid-Atlantic* stock. Re-examine the maturity ogive to incorporate any recent research results.

Update or conduct regional maturity studies for the *Gulf of Maine* stock. This may require a maturity workshop to ensure the use of standardized criteria among regional studies.

LIFE HISTORY STUDIES

Mortality Estimates

American Eel

Investigate survival and mortality rates of different life stages (leptocephalus, glass eel, yellow eel, and silver eel) to assist in the assessment of annual recruitment. Such research could be aided by continuing and initiating new tagging programs with individual states.

Regular periodic stock assessments and determination of fishing mortality rates (F) are required to develop a sustainable harvest rate in addition to determining whether the population is stable, decreasing, or increasing.

Determine mortality rates at different life history stages (leptocephalus, glass eel, yellow eel, silver eel), and mortality rates with size of the yellow eel stage. Determine sustainable fishing mortality rates (F) for eel.

American Lobster

Initiate studies of life history events (molting, extrusion, mortality, etc.) in older/larger lobsters on a regular basis.

Include process error in growth, reproduction, etc; and evaluate effects of assumptions of maximum intermolt periods, maximum size and the partitioning of natural mortality in the egg production per recruit model. Obtain information on molting frequency and lobster growth, mortality, and recruitment among years and geographical areas. (Estrella/Massachusetts has an ongoing hatchery study on this topic.)

Obtain information on natural mortality rates. The effects of alternative partitionings of natural mortality (M) between hardshell and softshell should be investigated, and attempts should be made to estimate rates from field or laboratory data.

American Shad/River Herring

Validate the different values of M for shad stocks through verification of shad aging techniques and repeat spawning information and develop methods for calculating M.

Evaluate additional sources of mortality for shad, including bait and reduction fisheries.

Conduct studies of egg and larval survival and development.

Quantify fishing mortality (in-river, ocean bycatch, bait fisheries) for major river stocks after ocean closure of directed fisheries.

Atlantic Croaker

Evaluate hook and release mortality under varying environmental factors and fishery practices.

Atlantic Menhaden

Evaluate effects of selected environmental factors on growth, survival and abundance of juvenile and adult menhaden, particularly in Chesapeake Bay and other coastal nursery areas.

Re-evaluate menhaden natural mortality, by age and response to changing predator population sizes.

Atlantic Sea Herring

Reinvestigate the estimation of age-3 herring, investigate the natural mortality rate assumed for all ages, the use of catch-per-unit-effort tuning indices, and the use of NEFSC fall bottom trawl survey tuning indices in the analytical assessment of herring.

Black Sea Bass

Investigate the effect of sex transition rates, sex ratio and differential natural mortality by sex on the calculation of spawning stock biomass per recruit and eggs per recruit. Also, investigate the impact on reproduction of removal of large males from the population.

Studies on sex-specific mortality rates and growth are needed.

Bluefish

Work should continue on catch and release mortality.

Horseshoe Crab

Investigate larval and juvenile survival and mortality to assist in the assessment of annual recruitment.

Estimate fishing discard numbers and associated mortality rates.

Northern Shrimp

Evaluate natural mortality, including relative impacts of predation and disease and variation at age and over time.

Evaluate larval growth and survival in response to environmental conditions.

Red Drum

Develop a more reliable estimate of natural and fishing mortality through directed sampling of the adult population.

Continue tagging studies to determine stock identity, inshore/offshore migration patterns and mortality estimation.

Determine the survival rate of red drum following regulatory and voluntary discard from commercial and recreational gear, including recreational net fisheries. Evaluate effects of water temperature and depth of capture.

Identify the effects of water quality degradation on the survival of red drum eggs, post-larvae, larvae, and juveniles.

Scup

Quantify the percentage of commercial fishery trips that had discards but no landings, and evaluate how such trips contribute to the total commercial fishery discard estimate.

Commercial discard mortality had previously been assumed to be 100% for all gear types. The committee recommends that studies be conducted to better characterize the mortality of scup in different gear types to more accurately assess discard mortality.

Spanish Mackerel

Provide better estimates of recruitment, natural mortality rates, fishing mortality rates, and standing stock. Specific information should include an estimate of total amount caught and distribution of catch by area, season, and type of gear.

Summer Flounder

Undertake research to determine hooking mortality on summer flounder by circle, kahle, and regular "J" hooks and make the results of work already completed available to the Management Board.

Weakfish

Derive estimates of discard mortality rates and the magnitude of discards for all commercial gear types from both directed and non-directed fisheries. In particular, quantify trawl bycatch, refine estimates of mortality for below minimum size fish, and focus on factors such as distance from shore and geographical differences. Update the scale – otolith comparison for weakfish.

Continue studies on recreational hook-and-release mortality rates, including factors such as depth, warmer water temperatures, and fish size in the analysis. Further consideration of release mortality in both the recreational and commercial fisheries is needed, and methods investigated to improve

survival among released fish.

Document the impact of power plants and other water intakes on larval, post larval and juvenile weakfish mortality in spawning and nursery areas, and calculate the resultant impact to adult sock size.

Winter Flounder

Focus research on quantifying mortality associated with habitat loss and alteration, contamination by toxics and power plant entrainment and impingement for *coastwide* stock.

Research studies should be designed to provide reliable estimates of anthropogenic mortality from sources other than fishing on a *coastwide* basis. Both mortality sources should then be incorporated into fisheries yield/recruit models to simultaneously evaluate these dual mortality factors.

Examine the implications of anthropogenic mortalities caused by pollution and power plant entrainment in estimation of yield per recruit, if feasible (*Southern New England-Mid-Atlantic* stock).

LIFE HISTORY STUDIES

Recruitment Studies

American Eel

Investigate survival and mortality rates of different life stages (leptocephalus, glass eel, yellow eel, and silver eel) to assist in the assessment of annual recruitment. Such research could be aided by continuing and initiating new tagging programs with individual states.

Age at entry of glass eel into estuaries and fresh waters should be examined.

Location and triggering mechanism for metamorphosis from leptocephalus to eel should be examined.

American Lobster

Include process error in growth, reproduction, etc; and evaluate effects of assumptions of maximum intermolt periods, maximum size and the partitioning of natural mortality in the egg production per recruit model. Obtain information on molting frequency and lobster growth, mortality, and recruitment among years and geographical areas. (Estrella/Massachusetts has an ongoing hatchery study on this topic.)

Atlantic Menhaden

Develop and test methods for estimating size of recruiting year-classes of juveniles using fishery-independent survey techniques.

Evaluate use of coastal power plant impingement data as a possible means to estimate young-of-the-year menhaden abundance.

Atlantic Sea Herring

Develop new approaches to estimating recruitment (i.e. juvenile abundance) from fishery-independent data.

Atlantic Striped Bass

Continue to conduct research to determine limiting factors affecting recruitment and possible density implications.

Bluefish

Conduct research on oceanographic influences on bluefish recruitment, including information on migratory pathways of larval bluefish.

Horseshoe Crab

Investigate larval and juvenile survival and mortality to assist in the assessment of annual recruitment.

LIFE HISTORY STUDIES

Reproductive Biology (General)

American Eel

Triggering mechanism for metamorphosis to mature adult, silver eel life stage with specific emphasis on the size and age of the onset of maturity, by sex. A maturity schedule (proportion mature by size or age) would be extremely useful in combination with migration rates.

Investigate: fecundity, length and weight relationships for females throughout their range; growth rates for males and females throughout their range; predator-prey relationships; behavior and movement of eel during their freshwater residency; oceanic-behavior, movement and spawning location of adult mature eel; and all information on the leptocephalus stage of eel.

Mechanisms of recognition of the spawning area by silver eel, mate location in the Sargasso Sea, spawning behavior, and gonadal development in maturation should be researched.

Workshop on aging and sexing techniques should be considered to increase the accuracy of data collected in coastwide sampling program.

Investigate fecundity, length and weight relationships for females throughout their range, and growth rates for males and females throughout their range.

American Lobster

Obtain information on natural mortality rates. The effects of alternative partitionings of natural mortality (M) between hardshell and softshell should be investigated, and attempts should be made to estimate rates from field or laboratory data.

Atlantic Croaker

Examine reproductive biology of croaker with emphasis on developing maturity schedules and estimates of fecundity.

Atlantic Striped Bass

Determine inherent viability of eggs and larvae.

Black Sea Bass

Investigate the effect of sex transition rates, sex ratio and differential natural mortality by sex on the calculation of spawning stock biomass per recruit and eggs per recruit. Also, investigate the impact on reproduction of removal of large males from the population.

Horseshoe Crab

Estimate the proportion of sub-tidal spawning and determine if this effects spawning success (i.e. egg survivability).

Weakfish

Define reproductive biology of weakfish, including size at sexual maturity, maturity schedules, fecundity, and spawning periodicity. Continue research on female spawning patterns: what is the seasonal and geographical extent of "batch" spawning; do females exhibit spawning site fidelity?

LIFE HISTORY STUDIES

Species Identification

REFERENCE POINT ISSUES

American Lobster

Estimates of biological reference points for the Gulf of Maine stock are partly influenced by the assumed level of v-notching undertaken by area fishermen. No adequate estimate of the proportion of compliance with this voluntary measure now exists. A credible study of this issue is recommended to reduce uncertainty in estimation of biological reference points. (See Note in Reference Section concerning ongoing work.)

American Shad/River Herring

Determine and update biological benchmarks used in assessment modeling (fecundity at age, mean weight at age for both sexes, partial recruitment vector/maturity schedules) for American shad and river herring stocks in a variety of coastal river systems, including both semelparous and iteroparous stocks.

Develop and implement techniques to determine shad and herring population targets for tributaries undergoing restoration (dam removals, fishways, supplemental stocking, etc.).

Atlantic Croaker

The optimum utilization (economic and biological) of a long term fluctuating population such as croaker should be evaluated.

Atlantic Sea Herring

Consider using NEFSC fall survey mean weights at age as the spawning stock mean weight at age in the estimation of biological reference points. Evaluate alternative catch weights at age.

Evaluate the concept of a fixed spawning stock size or spawning target for the herring coastal stock complex. Determine the adequacy of present methods and data to set a target if appropriate.

Atlantic Striped Bass

Improve methods for determining population sex ratio for use in estimates of spawning stock biomass and biological reference points.

An evaluation of the overfishing definition should be made relative to uncertainty in biological parameters.

Simulation models should be developed to look at the implications of overfishing definitions relative to development of a striped bass population which will provide “quality” fishing. Quality fishing must first be defined.

Horseshoe Crab

Develop biological reference points (such as natural mortality rates, growth rates, fecundity, etc.).

Northern Shrimp

Evaluate appropriate biological reference points and define sustainable harvest levels. The potential for improving estimates of mortality, abundance, and biomass from historical fishery and survey data from the 1960s should be investigated for further guidance on appropriate biological reference points.

Scup

Explore sensitivity of YPR reference points to changes in input parameters.

Explore alternative biomass indices for development of biomass proxies for reference point determination based on multiple survey indices.

Evaluate the current biomass reference point and consider alternative proxy reference points such as B_{MAX} (the relative biomass associated with F_{MAX}).

Winter Flounder

Update age-based biological reference points for the GOM stock and examine other biological reference points and rebuilding strategies in projection models.

MANAGEMENT RELATED ISSUES

American Lobster

Monitor the condition of the stocks and determine the effects of management measures and environmental changes on the abundance of the stocks and on the fisheries.

American Lobster

Determine the effects of regulations on the fishery, the participants and the stock.

Atlantic Sea Herring

Evaluate the concept of a minimum biologically-acceptable level biomass (MBAL) for the herring coastal stock complex. Determine the adequacy of present methods and data to determine MBAL if appropriate.

Weakfish

Define restrictions necessary for implementation of projects in spawning and overwintering areas and develop policies on limiting development projects seasonally or spatially.

GENERAL INFORMATION AND STUDIES

GENERAL INFORMATION AND STUDIES

Stocking Programs

American Shad/River Herring

Develop effective culture and marking techniques for river herring.

Refine techniques for hormone induced tank spawning of American shad. Secure adequate eggs for culture programs using native broodstock.

Atlantic Striped Bass

Juvenile and adult surveys should be continued to determine the most cost-effective release strategies including age at release and optimal release conditions such as salinity, temperature, and time of day for future potential stocking programs.

Atlantic Sturgeon

Develop sperm cryo-preservation techniques and refine to assure availability of male gametes. Refine induced spawning procedures.

Conduct basic cultural experiments to provide information on: a) efficacy of alternative spawning techniques, b) egg incubation and fry production techniques, c) holding and rearing densities, d) prophylactic treatments, e) nutritional requirements and feeding techniques, and f) optimal environmental rearing conditions and systems.

Establish stocking goals and success criteria prior to development of stock enhancement or recovery programs.

Conduct research to identify suitable fish sizes, and time of year for stocking cultured fish.

Conduct and monitor pilot-scale-stocking programs before conducting large-scale efforts over broad geographic areas.

Develop the capability to capture wild broodstock and develop adequate holding and transport techniques for large broodstock.

Conduct a cost benefit analysis of various stocking protocols.

Red Drum

Fully evaluate the efficacy of using cultured red drum to restore native stocks along the Atlantic coast, including cost-benefit analyses.

GENERAL INFORMATION AND STUDIES

Aquaculture Programs

Black Sea Bass

Develop mariculture techniques.

Summer Flounder

Conduct the basic research necessary to develop land and pen culture techniques.

GENERAL INFORMATION AND STUDIES

Tagging Programs

American Eel

Investigate survival and mortality rates of different life stages (leptocephalus, glass eel, yellow eel, and silver eel) to assist in the assessment of annual recruitment. Such research could be aided by continuing and initiating new tagging programs with individual states.

American Lobster

Resolve the question of stock identification, particularly as related to inshore/offshore components south of Georges Bank. Appropriate genetic studies are highly recommended and a compilation and analysis of existing tagging data should be undertaken prior to any new tagging studies. (Bruce Estrella complied tagging studies in the early 1990s. The Technical Committee concluded that this compilation was fruitless because many databases were lost and the lack of consistent information across studies made it difficult for comparisons. See Note in References Section concerning work being conducted by the NEFSC).

Compile existing tagging data-transfer rates.

American Shad/River Herring

Determine which stocks are impacted by coastal intercept fisheries (including bycatch fisheries). Methods to be considered to differentiate among stocks could include otolith micro-chemistry, oxy-tetracycline otolith marking and/or tagging.

Atlantic Croaker

Determine migratory patterns and mixing rates through cooperative, multi-jurisdictional tagging studies.

Atlantic Striped Bass

Examine differential reporting rates between commercial and recreational fishermen using high reward tags.

Atlantic Sturgeon

Develop and implement long-term marking/tagging procedures to provide information on individual tagged Atlantic sturgeon for up to 20 years.

Identify rates of tag loss and tag reporting.

Black Sea Bass

A tagging program should be initiated through state fisheries agencies to estimate mortality independent of traditional methods.

Bluefish

Study tag mortality and retention rates for the American Littoral Society dorsal loop and other tags used for bluefish.

Horseshoe Crab

Conduct tagging studies (mark-recapture) to determine the incidence of repeated spawning and dispersal parameters.

Red Drum

Continue tagging studies to determine stock identity, inshore/offshore migration patterns and mortality estimation.

Spot

Determine migratory patterns through tagging studies.

Summer Flounder

Develop stock identification methods via meristics, morphometrics, biochemical research and tagging; particularly off Virginia and North Carolina.

Weakfish

Identify stocks and determine coastal movements and the extent of stock mixing, including characterization of stocks in overwintering grounds. (e.g. tagging).

Develop a coastwide tagging database.

GENERAL INFORMATION AND STUDIES

Environmental Effects

American Lobster

Monitor the condition of the stocks and determine the effects of management measures and environmental changes on the abundance of the stocks and on the fisheries.

Examine temperature effects on growth, reproduction, etc. (Many lab studies have been done, but have not been related to the EPR model in the form of an environmental component.)

Undertake regional examination of temperature-yield relationship. (Estrella, Bruce, and Steven Cadrin. 1991. Massachusetts coastal commercial lobster trap sampling program, 1990 Annual Report. 52 pp.; Fogarty, Michael J. 1988. Time series models of Maine lobster fishery: Effects of temperature. Canadian Journal of Fisheries and Aquatic Sciences, Volume 45, 1145-1153.)

Examine temperature, effort, and abundance effects on catch.

Use comparative evaluations of reproductive rates with respect to temperature.

Test the thermal limit hypothesis.

American Shad/River Herring

Review studies dealing with the effects of acid deposition on anadromous alosids.

Atlantic Menhaden

Evaluate effects of selected environmental factors on growth, survival and abundance of juvenile and adult menhaden, particularly in Chesapeake Bay and other coastal nursery areas.

Atlantic Sturgeon

Establish tolerance of different life stages to important contaminants and levels of such environmental factors such as DO, pH, and temperature.

Bluefish

Conduct research on oceanographic influences on bluefish recruitment, including information on migratory pathways of larval bluefish.

Scientific investigations should be conducted on bluefish to develop an understanding of the long term, synergistic effects of combinations of environmental variables on various biological and sociological parameters such as reproductive capability, genetic changes, and suitability for human consumption.

Studies on the interactive effects of pH, contaminants, and other environmental variables on survival

of bluefish.

Northern Shrimp

Evaluate larval growth and survival in response to environmental conditions.

Red Drum

Determine habitat preferences, environmental conditions, growth rates, and food habits of larval and juvenile red drum throughout the species range along the Atlantic coast. Assess the effects of environmental factors on stock density.

Scup

It is necessary that scientific investigations be conducted on scup to emphasize the long term, synergistic effects of combinations of environmental variables on, for example, reproductive capability, genetic changes, and suitability for human consumption.

Conduct studies on the interactive effects of pH, contaminants, and other environmental variables on survival of scup.

Spiny Dogfish

Analyze the effects of environmental conditions on survey catch rates.

Spotted Seatrout

Evaluate effects of environmental factors on stock density.

Summer Flounder

Evaluate effects of dissolved oxygen and water current requirements for adult summer flounder and summer flounder eggs.

Evaluate the relationship between recruitment of summer flounder to nursery areas and Ekman transport or prevailing directions of water flow.

Weakfish

Conduct hydrophonic studies to delineate weakfish spawning habitat locations and environmental preferences (temperature, depth, substrate, etc.) and enable quantification of spawning habitat.

GENERAL INFORMATION AND STUDIES

Social and Economic Information

American Eel

The historic participation level of subsistence fishers in wildlife management planning needs to be reviewed, and relevant issues brought forth with respect to those subsistence fishers involved with American eel.

Economics studies are necessary to determine the value of the fishery and the impact of regulatory management.

The degree of dependence on the American eel resource by subsistence harvesters such as Native American Tribes, Asian and European ethnic groups, etc. needs to be investigated.

American Lobster

Obtain information on operational and socioeconomic data for the commercial fisheries.

American Shad/River Herring

Conduct and evaluate historical characterization of socio-economic development (potential pollutant sources and habitat modification) of selected shad rivers along the east coast.

Atlantic Croaker

The optimum utilization (economic and biological) of a long term fluctuating population such as croaker should be evaluated.

Atlantic Menhaden

Periodically monitor the economic structure and sociological characteristics of the menhaden reduction industry.

Atlantic Sea Herring

Develop economic analyses necessary to evaluate the costs and benefits associated with different segments of the industry.

Develop socio-economic analyses appropriate to the determination of optimum yield.

Atlantic Sturgeon

Conduct a cost benefit analysis of various stocking protocols.

Northern Shrimp

Perform cost-benefit analyses to evaluate management measures.

Develop an understanding of product flow and utilization through the marketplace; identify performance indicators for various sectors of the shrimp industry.

Red Drum

States with significant fisheries should be encouraged to collect socio-economic data on red drum fisheries through add-ons to the MRFSS or by other means so as to determine the economic value of the Atlantic coast recreational red drum fishery.

Spanish Mackerel

Encourage the consideration of MRFSS add-ons or other mechanisms for collection of socioeconomic data for recreational and commercial fisheries.

Spiny Dogfish

Update on a regular basis the characterization of fishing communities involved in the spiny dogfish fishery, including the processing and harvesting sectors, based upon Hall-Arber et al. (2001) and McCay and Cieri (2000).

Characterize the value and demand for spiny dogfish in the biomedical industry on a state by state basis.

Develop procedures for evaluating alternative opportunities and the mortality impacts that result from this switching to alternative opportunities behavior. Use Multinomial logit and random utility models to provide information on future trip limit analyses and expand upon Steinback and Thunberg's (2002) trip limit analysis. Trip limit cost estimates should be corroborated through industry advisor input or through other sources of data. Sensitivity analyses of Steinback and Thunberg's (2002) analysis should be conducted in the future to determine the range of possible outcomes.

Characterize the spiny dogfish processing sector.

Monitor the changes to the foreign export markets for spiny dogfish, and evaluate the potential to recover lost markets or expand existing ones.

Spotted Seatrout

Collection of social and economic aspects of the spotted seatrout fishery should be initiated.

Summer Flounder

Conduct a detailed socio-economic study of the summer flounder fisheries.

Weakfish

Assemble socio-demographic-economic data as it becomes available from ACCSP.

GENERAL INFORMATION AND STUDIES

Contaminants and Chemicals

American Eel

Contaminant effects on eel and the effects of bioaccumulation with respect to impacts by age on survival and growth and effect on maturation and reproductive success should be researched.

American Shad/River Herring

Identify pheremones or other chemical substances used by American shad to locate conspecifics. Develop methods to isolate or manufacture these chemicals and use them to attract shad into fish passage facilities to improve fish passage and efficiency.

Atlantic Sturgeon

Establish tolerance of different life stages to important contaminants and levels of such environmental factors such as DO, pH, and temperature.

Horseshoe Crab

Evaluate the effect of mosquito control chemicals on horseshoe crab populations.

Tautog

Define the susceptibility of juveniles to coastal/anthropogenic contamination and resulting effects. This information can explain differences in local abundance, movements, growth, fecundity, and serve to support continued or increased regulation of the inputs of these contaminants and to assess potential damage. Since oil spills seem to be a too frequent coastal impact problem where juvenile tautog live, it may be helpful to conduct specific studies on effects of various fuel oils and typical exposure concentrations, at various seasonal temperatures and salinities. Studies should also be conducted to evaluate the effect of common piling treatment leachates and common antifouling paints on young of the year tautog. The synergistic effects of leaked fuel, bilge water, treated pilings, and antifouling paints on tautog health should also be studied.

Winter Flounder

Focus research on quantifying mortality associated with habitat loss and alteration, contamination by toxics and power plant entrainment and impingement on a *coastwide* basis.

Examine the implications of anthropogenic mortalities caused by pollution and power plant entrainment in estimation of yield per recruit, if feasible (*Southern New England-Mid-Atlantic* stock).

GENERAL INFORMATION AND STUDIES

Diseases

Atlantic Menhaden

Determine the effects of fish diseases (such as ulcerative mycosis and toxic dinoflagellates) on the menhaden stock.

Monitor fish kills along the Atlantic coast and use the NMFS Beaufort Laboratory as a repository for these reports.

Atlantic Striped Bass

Additional research should be conducted to determine the pathogenicity of the IPN virus isolated from striped bass to other warm water and marine species, such as flounder, menhaden, shad, largemouth bass and catfish.

Atlantic Sturgeon

Research should be conducted to determine the susceptibility of Atlantic sturgeon to sturgeon adenovirus and white sturgeon iridovirus. Methods should be developed to isolate the sturgeon adenovirus and an Atlantic sturgeon cell line should be established for infection trials.

Research should be conducted to identify the major pathogens of Atlantic sturgeon and a cell line for this species should be developed.

Bluefish

Investigate the relationship of epidemic dermatological disease of bluefish exhibited in the Tar-Pamlico estuary to environmental toxics or other parameters.

Northern Shrimp

Evaluate natural mortality, including relative impacts of predation and disease and variation at age and over time.